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Compressed Air Magazine

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SPECIAL CANADIAN NUMBER

NOVEMBER, 1923

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CANADA'S WATERCOURSES CAN DEVELOP 20,000,000 H.P., WHILE HER FORESTS CONTAIN 800,000,000,000 FEET OF COMMERCIAL TIMBER

Canada Holds Conspicuous Position in Paper-Making Industry
S. G. Roberts

Electrical Energy from the Saguenay River
A. A. Bowman

Oil-Engine Drive Promotes Ice-Plant Efficiency
Robert G. Skerrett

Canada's Great Asbestos Industry
Norman R. Fisher

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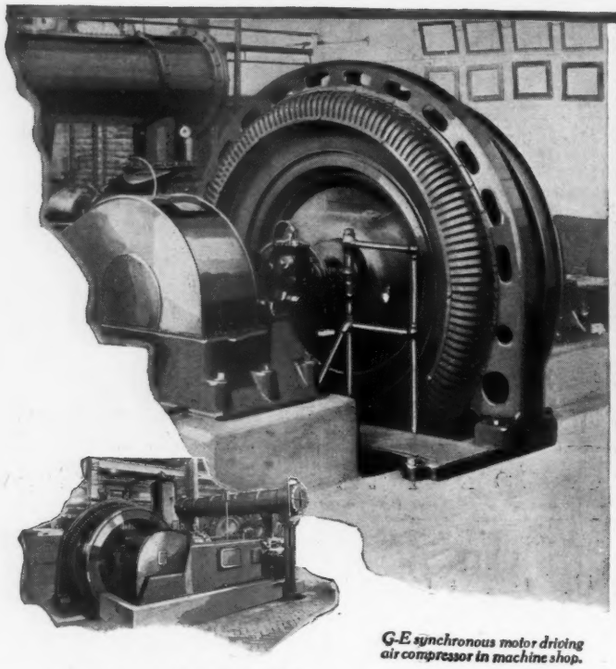
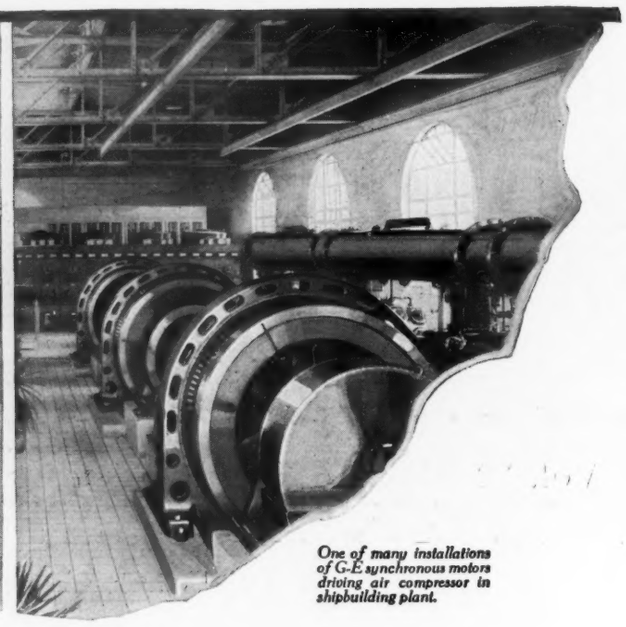
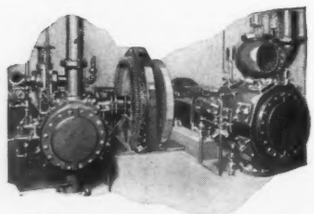


G-E synchronous motor driving air compressor in machine shop.

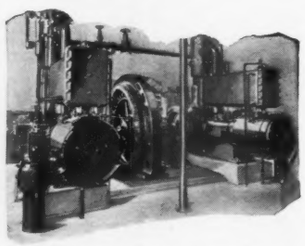


One of many installations of G-E synchronous motors driving air compressor in shipbuilding plant.

A big electrical industry uses this G-E synchronous motor for driving air compressor.



G-E synchronous motor driving air compressor in automobile factory.



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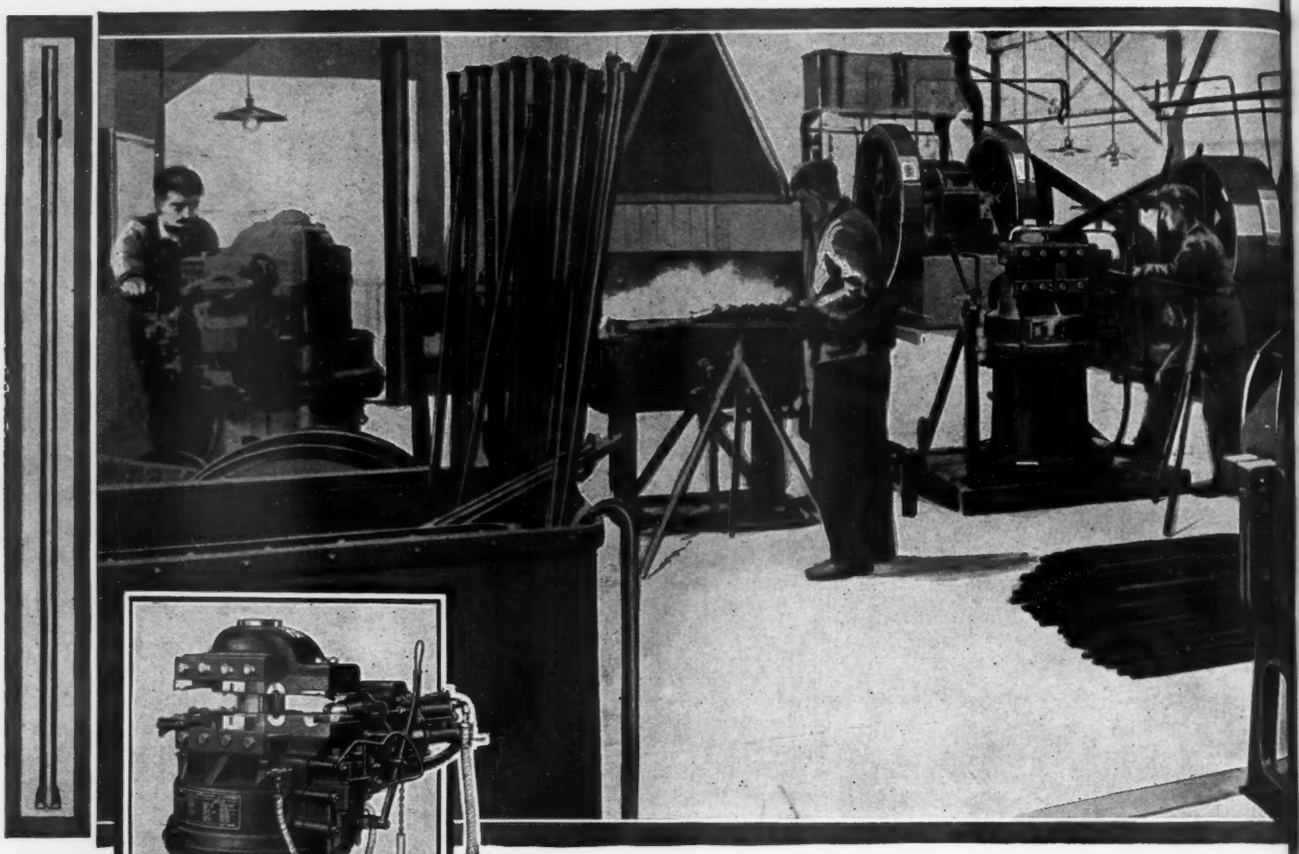

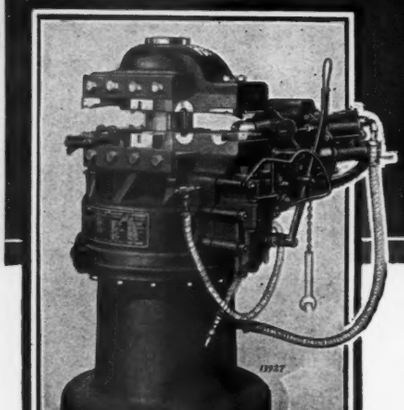

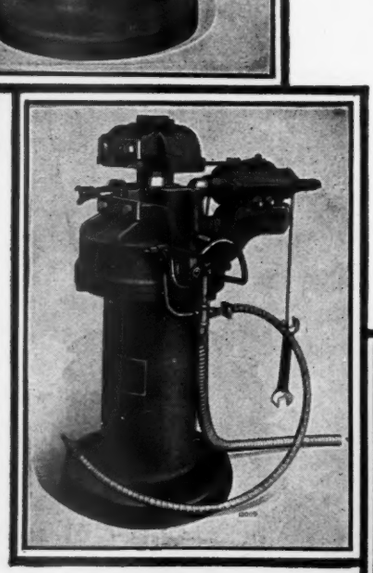

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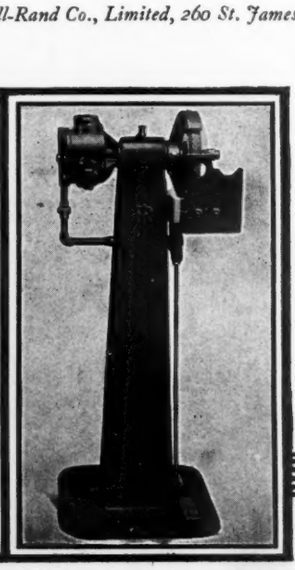

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Canada's Position in the Paper-Making Industry One of Rapidly Increasing Importance

An Abundance of Relatively Low-priced Power and the Availability of Vast Tracts of Virgin Forest Contribute to Her Success in this Department of Manufacturing

By S. G. ROBERTS

NEWSPRINT paper worth more than $35,000,000 was shipped out of Canada during the first six months of the present year. In other words, the Dominion manufactured in that period 683,474 tons of that commodity, and exported 80 per cent. thereof. These figures are decidedly significant, inasmuch as the economist tells us that the industrial prosperity of a country can, in a general way, be measured by the volume and the value of its exports. It might be mentioned here that Canada also exported between January 1 and the end of June no less than 327,280 tons of wood pulp which has been or will be worked up into paper by the purchasers. Our neighbor to the north has fully 20-odd companies within her boundaries engaged in the paper-making business.

Interesting as it might be to describe the activities at a number of the Canadian paper mills, space forbids and we must, therefore, confine ourselves to detailing the procedure and the facilities at a single typically modern plant, that of the St. Maurice Lumber Company at Three Rivers, Quebec. Here it is that electrical energy, generated at Shawinigan Falls, is utilized extensively in transforming the timber of far-away forests first into wood pulp and then into the finished article, newsprint.

The still quaint town of Three Rivers, where the romance of ancient New France commingles with present-day progress and commercialism, is the outgrowth of a settlement established by Champlain nearly 300 years ago when that famous pioneer journeyed up the St. Lawrence from Quebec. Three Rivers is situated at the junction of the St. Maurice with the St Lawrence and is so named because the mouth of the tributary is divided into three outlets by two islands. So far as paper making is concerned, Three Rivers is admirably placed, because the St. Maurice offers an easy route for the logs originating in the forests a hundred or more miles to the northward while the St. Lawrence and the Canadian Pacific Railway, respectively, offer easy outlets by water and by land for the finished product. A number of large paper mills are, accordingly, located at or near this charming old town.

THE daily paper is an informative and an educational necessity. In satisfying the thirst for news of many millions of people, thousands of tons of newsprint paper are required every 24 hours.

The average reader has only a hazy understanding of the sources of this essential paper and, as a rule, he knows very little about the processes by which the primary raw materials are worked into the printable sheet.

Curiously, the primeval forest furnishes most of the timber from which modern newsprint is produced. Year by year, Canada is supplying the world with more and more paper of this kind, and the importance of this branch of her industrial life is growing apace.

The purpose of the accompanying article is to tell something about the manufacture of newsprint and, incidentally, to describe one of the largest and most up-to-date of the mills engaged in this field of activity.

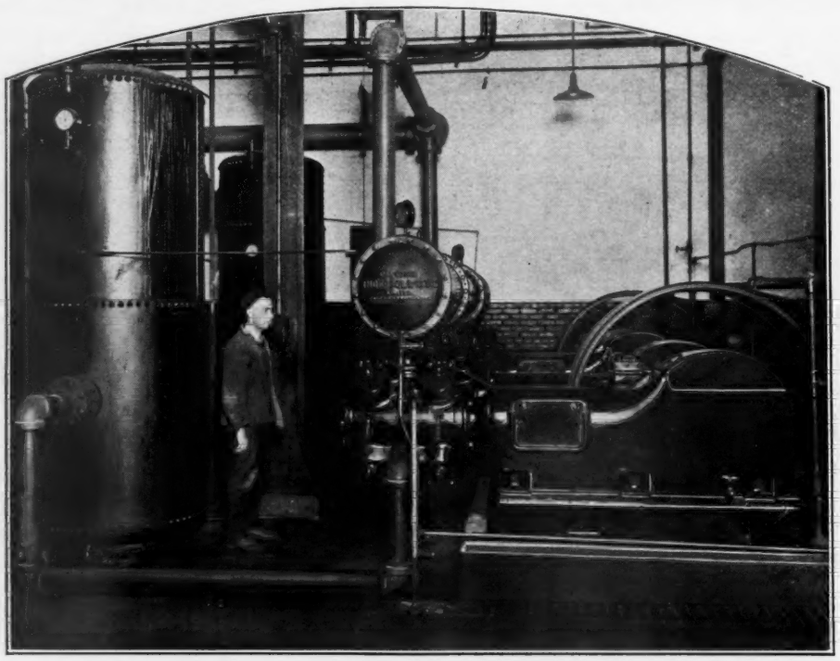
The mill which we are about to deal with is owned by the St. Maurice Lumber Company, a subsidiary of the International Paper Company, and was first put in operation a little over a year ago. The plant represents the climax of years of experience, and everything new and worth while has been embodied in this establishment, which is now turning out 300 tons of newsprint daily.

To the man in the street, the figure 300 tons conveys an utterly inadequate impression of the magnitude of this output or of the work that must be done in achieving the seeming miracle of changing logs into paper for the feeding of the well-nigh insatiable printing press. The four newsprint machines with which the mill is equipped fabricate in the course of 24 hours a matter of 76,658,400 square feet of paper which, made into a single sheet, would be ample to cover an expanse of 1,760 acres. Further, if this paper were cut into a ribbon 6 inches wide it would have a total length of 29,036 miles—that is, be long enough to encircle the earth at the equator with more than 4,000 miles to spare. Each ton of paper represents the utilization of 1¼ cords of wood averaging 90 per cent. spruce and 10 per cent. balsam or fir. A quarter of this raw material is pulped by a chemical process while the remaining three-quarters is ground to the desired fineness by a battery of big grindstones. The reason for the difference in treatment will be explained presently.

Aside from an abundance of suitable wood, the manufacture of newsprint calls for the use of large volumes of water and a tremendous amount of power derived from steam or a hydro-electric source. In the case of the mill of the St. Maurice Lumber Company, the greater part of the needful energy is generated by the St. Maurice River where it drops abruptly in its course a few miles north of Three Rivers. In its employment of electricity the plant is unique because substantially every mechanical movement is due to the drive of one or more electric motors. Both direct current and alternating current are utilized, and these are so interrelated that operative economy is real-

ized in combination with unusual flexibility which takes care of wide ranges and sudden changes in load.

All water distributed within the plant is drawn from the St. Maurice, and after passing through five large cylindrical screens it is either sent direct to the mill or is further treated in a series of twenty filter beds which extract all impurities. The latter precaution is necessary in the preparation of paper stock or pulp and is helpful to the boilers because it assures a feed which will not foul the tubes and lower the efficiency of the steam generators. It is in cleansing the filter beds that compressed air performs its first service in the factory. Air jets, lying beneath the sand bed, discharge upward through the filtering mass; and the water above the bed carries off the harmful or undesirable solid matter thus released.

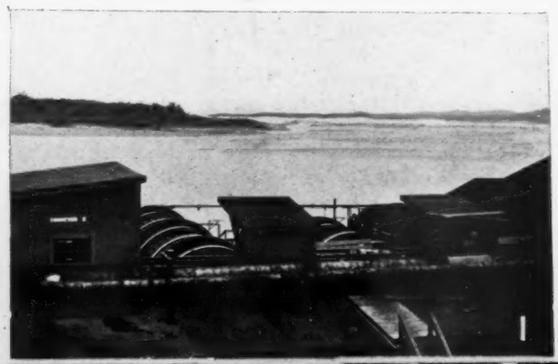


Essential air for certain of the processes is supplied by two 16 and 10x12-inch Canadian Ingersoll-Rand, Ltd., PLB-2 compressors.

A group of nine electrically driven Cameron centrifugal pumps take water from the river and circulate it from end to end of the mill, and these pumps are of sufficient capacity to handle in the course of 24 hours fully 80,000,000 gallons—enough water to meet generously the demands of a big city. There are 50-odd other pumps of the same make, large and small, in different departments of the plant for distributing acid, porridge-like paper stock, and "white water" or the spent liquor recovered from the paper machines, screens, etc. And now let us follow the divers steps in the manufacture of newsprint paper.

At the start should be mentioned the reason why the paper is made up of 25 per cent. sulphite or chemical pulp and of 75 per cent. ground wood or mechanical pulp. The process by which chemical pulp is produced yields fibers which are considerably longer than the fibers obtained when logs are pulped by grinding, and these longer fibers impart strength and serve to bind together or to felt the more numerous and shorter fibers of the mechanical pulp. Without the use of a suitable percentage of sulphite pulp it would not be practicable to fabricate from wood stock newsprint which would be strong enough to withstand the stresses to which the paper is necessarily subjected in the present-day, high-speed press. The fiber of the spruce is superior to that of many other woods owing to its length and averages about ⅛ inch. Poplar, which is extensively utilized in paper making, has a fiber length of approximately 1/25 inch.

The logs worked into paper reach the mill for the most part by being floated down the St. Maurice; and from the time a tree is felled in the distant forest until its wood reaches either the grinders or the sulphite digesters may be a matter of two or three years. Months of this period may pass while the sawed logs are drying out in the towering piles which are accumulated in the yard of the plant during the open season of the year from June 1 to October. At Three Rivers there are three such stacks, each of which when complete contains more than 20,000 cords. A "jack ladder" conveyer, capable of handling 16,000 logs in the course of a day, draws the 13-foot sticks up from the river and runs them against the saws of the slasher which cut the logs into 4-foot lengths—most of the butts, sawdust, and other wood waste being carried mechanically to a steam plant which utilizes these by-products. The 4-foot pieces, after leaving the slasher, are transported by traveling belts or conveyers to three big Sherbrooke revolving barking drums. The logs are fed in at one end of the drums and issue steadily from the other end, and during their tumbling journey they are knocked together enough to rid most of them of their water-soaked bark. About 10 per cent. of them have to make a second journey through the barking drums to strip them clean. From the barking drums the logs travel by cable conveyers which distribute the 4-foot lengths to three stackers, and these, in their turn, drop them onto the growing piles. Finally, the logs are picked



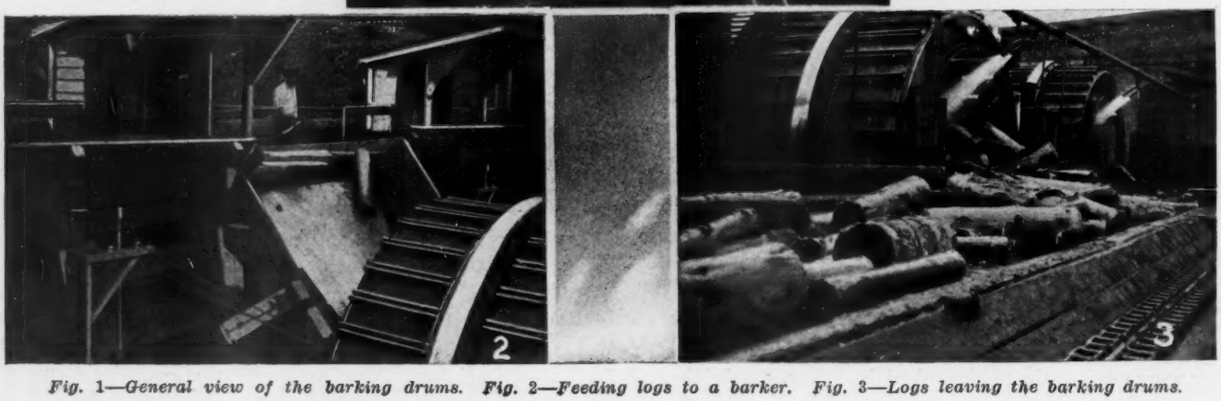


Fig. 1—General view of the barking drums. Fig. 2—Feeding logs to a barker. Fig. 3—Logs leaving the barking drums.

Fig. 1—Up the "jack ladder" conveyer 16,000 logs are moved daily from the river to the saws which cut the sticks into suitable lengths for feeding to the rotary barkers. Fig. 2—Mechanical stackers pile the barked sticks into towering pyramids each of which contains, when complete, about 20,000 cords of wood. These piles are the reserve upon which the mill draws in the closed season. Fig. 3—In the mechanical pulp mill. The logs are fed by two vertical magazines to each grinder, the whirling stone of which is visible through the opening above the numeral 7. Fig. 4—Charging floor of the digester house of the sulphite mill. The chipped wood is fed from the overhead bin by gravity to the digesters. The receiving end of one of the digesters is in the foreground at the left. Fig. 5—Wet end of one of the four big newsprint paper machines which together produce 300 tons of paper daily. Fig. 6—Drying rolls and winder of one of the newsprint machines. The paper comes from the calender rolls and is run onto the winder at the rate of 975 feet a minute. This speed would be impracticable were it not for the service performed by compressed air.

up and delivered by another system of power-driven conveyers to the sulphite and the ground-wood departments of the mill.

The ground-wood department is equipped with a formidable battery of fourteen grinders of the Watrous magazine type, and each pair of these machines is driven by a direct-connected, synchronous motor of 2,400 H.P. The 4-foot logs are fed by two vertical chutes or magazines to each stone, and the sticks are forced lengthwise against directly opposite points on the periphery of the stone, which has a diameter of 60 inches, a grinding face 54 inches wide, and makes 240 revolutions a minute. A hydraulic piston, operated by a pressure of 150 pounds, shoves the logs of the lower layer in each magazine forward against the stone, and this movement continues until all the logs in that layer are successively ground up. With this done, the piston is automatically retracted by a hydraulic pressure of 50 pounds, and then another layer of logs drops into position and the piston advances as before.

The friction developed in grinding the wet logs would soon start a blaze but for a steady stream of "white water" which falls both upon the stone and the logs immediately in contact with it. The working pressure for the 28 hydraulic pistons is maintained by two accumulators connected with pumps. These accumulators are really nothing more than strong, cylindrical, steel tanks in which the hydraulic pressure is built up and held at the point desired. A novel feature of these accumulators is a cushion of compressed air above the surface of the column of water in each tank. This air cushion plays the part of a shock absorber, stabilizes the pressure in the line as the numerous pistons move forward and backward, and thus neutralizes any hammer-blow effect which might otherwise cause trouble. Compressed air is also employed at frequent intervals to clean the grinder motors.

Each grinder is capable of producing in the course of 24 hours the equivalent of 20 tons of air-dry pulp; and on each machine there is a toothed wheel, held in contact with the wood, which serves to record the quantity actually ground. Further, each grinder is provided with a built-in burring lathe which is brought into action every three hours; and this auxiliary keeps the stone in good condition without in any way interfering with production. From the grinders, the pulp is conveyed to sliver screens of large area, and the pulp which passes through these screens is carried thence to a raw-stock tank having a capacity of 96,000 gallons.

It is not practicable in the present article to enter into the details of the succeeding operations by which the pulp is further screened, thinned with "white water," mixed with sulphite pulp, again screened, and finally diluted to the desired consistency just before it is turned onto the wire belt of the paper-making machine. Suffice it to say, that much care must be exercised at each step of these varied operations in order to insure an ultimate product of the desired quality. Certain by-products of the refining of both mechanical and chemical pulp are utilized to make the heavy wrapping paper which envelopes each roll of newsprint before it is shipped from the mill. Now let us transfer our attention to the sulphite department and to the preparation of the logs for treatment by the digesters.

As a preliminary, the cleanest of the logs are picked out at a suitable point in the conveyer system and sent on their way to a building in which are installed two chippers, each of which is driven by a 125-H.P. motor. Fundamentally, a chipper is made up of a heavy 7-foot disk in which are set radially three sharp steel blades mounted much after the fashion of the blade of a carpenter's plane. According to their condition, the logs are run through a special drum barker, and should any of the sticks have knots or discolored spots these logs are subsequently treated by a 50-H.P. knife barker which removes the defects. Afterwards, the logs are fed singly or by twos and threes—depending on their size—down a chute to each chipper, where they are brought end on against the revolving blades at an angle of 45 degrees. The thin chips have a length with the grain of about ¾ inch and may measure an inch or more in the other direction. The wood is chipped in this manner to facilitate the action of the acid which penetrates along the grain and thus dissolves the resinous matter surrounding the fibers or cellulose.

From the chippers, the chips are carried to inclined oscillating screens which separate the oversize chips from those of suitable sizes, and the former are conveyed to a rechipper and thence taken back to the screens for resizing. Sawdust and other kindred fine wood waste are transported by a belt conveyer to a boiler house which utilizes this refuse in raising steam. All chips of acceptable size on leaving the screens are moved mechanically to the chip bin at the top of the digester house. This bin is a V-shaped receptacle placed above the charging floor of the sulphite mill, and the arrangement is such that the chips feed by gravity to the digester intakes located in the floor of the charging room. There are three digesters, and each of these measures from top to bottom 47 feet and has a diameter of 15 feet. They are heavy steel cylinders with cone-shaped tops and bottoms; and a single digester will accommodate 18½ cords of chipped wood and hold at a "cooking" a total of 11 tons of sulphite.

The acid used in digesting the chips is made from flowers of sulphur by first melting the mineral and then burning it in revolving, cylindrical furnaces. The fumes are withdrawn from the furnace by an induced draft of 1½-inch vacuum; cooled by passage through water-chilled pipes of lead; and then blown upward through a tower filled with limestone. As the gas ascends through the broken rock it meets a descending shower of water, and the latter absorbs the gas. The resultant chemical combination is technically known as bisulphite of lime; and it is this acid which is capable of freeing the wood fiber from the surrounding resinous and ligneous matter without injuring the desired cellulose. After a digester has been charged with chips, 2,200 gallons of acid are pumped into the digester at the bottom for each cord of wood—making a total of more than 40,000 gallons at each "cook." Of this solvent, not more than 800 gallons are subsequently recovered—the rest of the acid escaping in a gaseous form when the charge is blown. Heat stimulates the action of the acid, and therefore steam is admitted to the digester. During the first two hours the pressure is gradually brought up to 50 pounds, maintained at that point for two hours, and then increased progressively to 70 pounds—being held at the latter pressure until the cooking is finished at the conclusion of a total interval of eight hours. When the pressure is at 70 pounds the temperature is 316° F.

Compressed air performs a useful service in the sulphite mill by stirring up the chips in the bin whenever they tend to form "bridges" and fail to feed down regularly to the charging floor. Steam can be used for this purpose but is objectionable because it tends to add water to the chips which already contain about 25 per cent. of moisture, and any additional moisture slows up proportionately the action of the acid during digestion. It might be remarked here that the "stock" or finished pulp—whether chemical or mechanical—is thinned out, when it becomes too thick while standing in the stock tanks, by blowing compressed air through it. The air breaks up water pockets, which are apt to form, and distributes the water again throughout the mass.

From a digester the pulp is discharged into one of the big concrete blow pits. The blow pit is covered but has a perforated bottom by which waste liquor can drain off. While in the blow pit, the pulp is subjected to a washing process which is carried on for a number of hours; and at the conclusion of that time substantially every trace of acid is removed and nothing is left but the silky fibers of the sulphite pulp. This pulp, which is about 90 per cent. water, is pumped from the blow pit and delivered to a 35,000-gallon stock tank. This tank serves to stabilize the intermittent discharges of the digesters and to form a source from which to maintain a steady flow of pulp for the processes which follow. Before the sulphite pulp is ready for paper making it undergoes refining by passage through various types of screens, after which it is deposited in a so-called soft-stock tank, capable of holding 45,000 gallons of fluid sulphite, from which the pulp is withdrawn to feed the rapidly working paper machines.

So far, we have considered the preparation of mechanical and chemical pulp as separate activities. The next step in paper making requires that the two kinds of pulp be mixed in proper proportions and that enough "white water" be added to them to give the combination a suitable consistency carrying a little more than 96 per cent. of water. At Three Rivers, 25 per cent. rather than the usual 20 per cent. of sulphite pulp is used so that the forming paper will be strong enough to hold its own while being pulled through the paper machines at a speed of 900 feet and more a

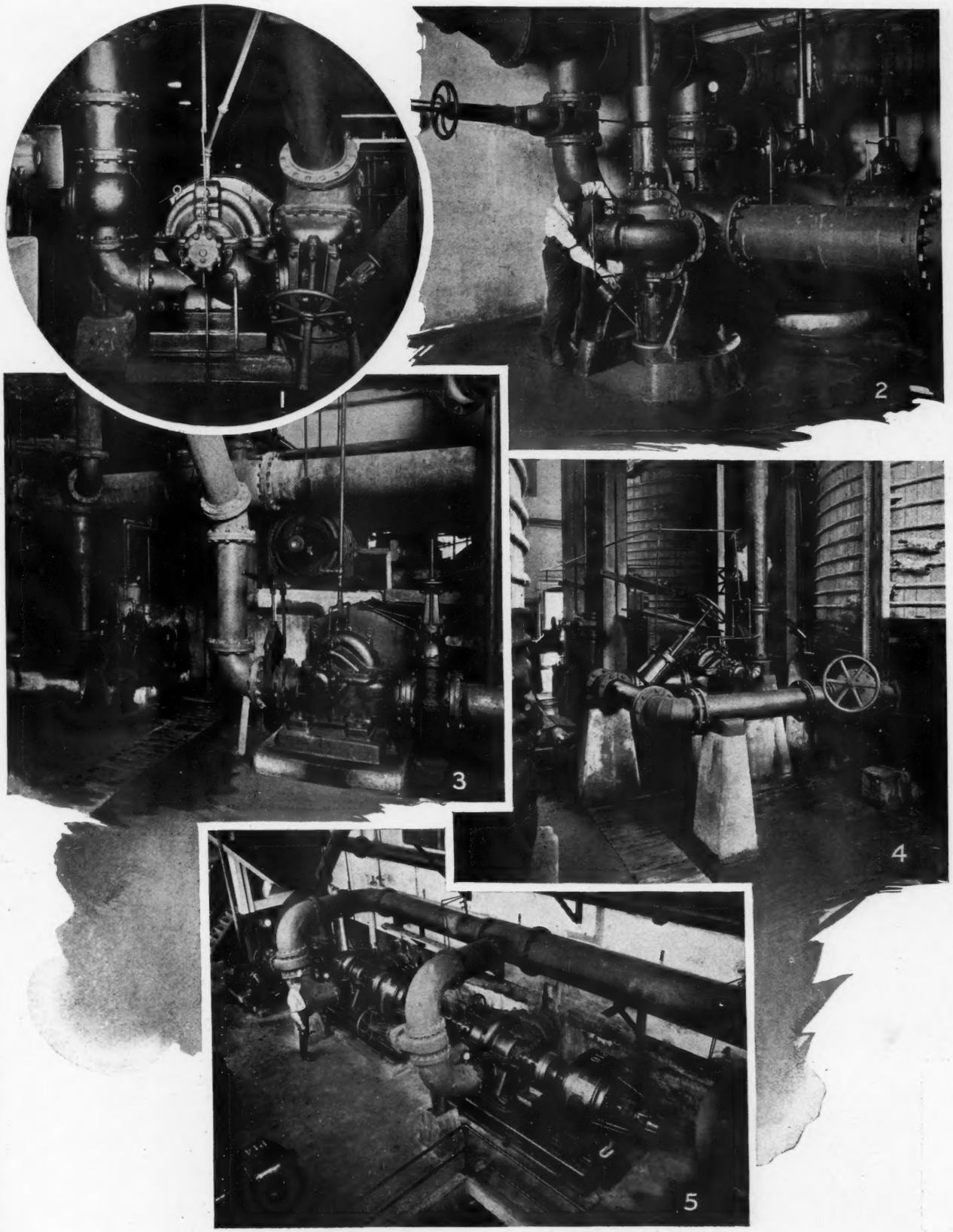


Fig. 1—This pump is delivering the mixed stock which is fed to one of the insatiable paper machines. Fig. 2—Close-up of one of the large units. There are nine pumps, large and small, located in the pump house, and they have a combined daily capacity of 80,000,000 gallons. Fig. 3—Here are seen still more centrifugal pumps. This time they are handling the "white water" or waste from the paper machines. Fig. 4—Centrifugal pumps are relied upon to distribute fluid stock in the sulphite mill. Paper making is largely a pumping proposition. Fig. 5—There are more than 65 pumps in the Three Rivers mill of the International Paper Company. Here are some of the great centrifugals, in the pump house, that draw water from the river and deliver it to different parts of the plant.

All the water used in the plant is drawn from the river and filtered through beds of sand. There are twenty of these beds, and the sand in them is cleansed frequently by sending streams of compressed air up through it.

minute. There is also added to the pulp a solution of alum and bluing that imparts to the finished product the desired color and opaqueness.

Again we must skip and come directly to the point where the flowing pulp, after being sprayed to suppress the formation of foam, falls upon the "wire" of the wet end of the paper machine. The mill is equipped with four Bagley & Sewell, 164-inch paper-making machines. Each machine is composed of nine independent but interrelated sections so coördinated that their speeds will exactly meet the requirements of the varying strength of the paper during its forming and finishing stages. Some understanding of what this nicety of adjustment amounts to can be gathered from the fact that the pulp reaches the machine 99½ per cent. water and issues from the calender rolls at the far end of the apparatus in a little more than half a minute as newsprint with a moisture content of but 10 per cent.

At the start, the stock pours onto the Fourdrinier wire—that is, a broad belt of brass or copper mesh—which travels on a slightly ascending course over two supporting rolls about 50 feet apart. The flow of the stock and the speed of the wire are substantially identical; and the film of pulp where it falls on the wire is about 5/8 inch thick. From the time the stock first touches the screen until it leaves it about three seconds later the water content is reduced to 75 per cent. and the original fluid is transformed into a sheet of paper of mush-like consistency and strong enough to be peeled from the wire and to be carried unsupported across a short gap to the rolls of the first press.

As can be readily grasped, the essential purpose of the Fourdrinier screen is to provide a sieve-like table on which the pulp fibers can be deposited and felted and a considerable percentage of the water content extracted the while—the forming film moving onward at the same time. The extraction of the water is induced by the action of gravity and further stimulated by a series of suction boxes placed at intervals under the screen and within the lower of the two couch rolls. These boxes extend the whole width of the wire and are subjected to the pull of a pump which maintains a vacuum ranging from ten to sixteen inches of mercury.

On leaving the couch rolls, the very plastic paper passes successively through a series of press rolls, being supported the while on a belting of wool felt. The under roll of the first press is equipped with a vacuum pump. The presses squeeze out more and more of the water in the paper; and by the time the sheet issues from between the last of the press rolls its moisture content has been cut down 66 per cent.—the paper gaining in strength by reason of this extraction. From the press-roll division of the machine the paper next enters the largest and heaviest part of the apparatus, that is, the dryer section. This is made up of a series of 44 revolving, cast-iron cylinders 13½ feet long and 5 feet in diameter. These cylinders are heated by steam exhausted from the turbines of the plant's local source of power; and they are geared together and carry a canvas belt having a total length of 600 feet and a width of 162 inches. This belt or "dryer felt," as it is called, holds the web of paper in close contact with the hot cylinders and prevents the paper from wrinkling and "cockling." Very heavy papers do not require this felt.

On issuing from the dryer section, the paper traces a sinuous course between the ten polished steel rolls of the calender. These rolls are arranged in a vertical stack, one above the other, and the paper starts with the top roll and works downward to the bottom where it comes out the finished product such as we are familiar with in the pages of our daily paper.

At the Three Rivers mill of the International Paper Company, the four machines are now turning out newsprint at the rate of 975 feet a minute! It would be quite impossible to do this without the aid of compressed air. Compressed air is utilized to lace the narrow ribbon of a new sheet of paper through the

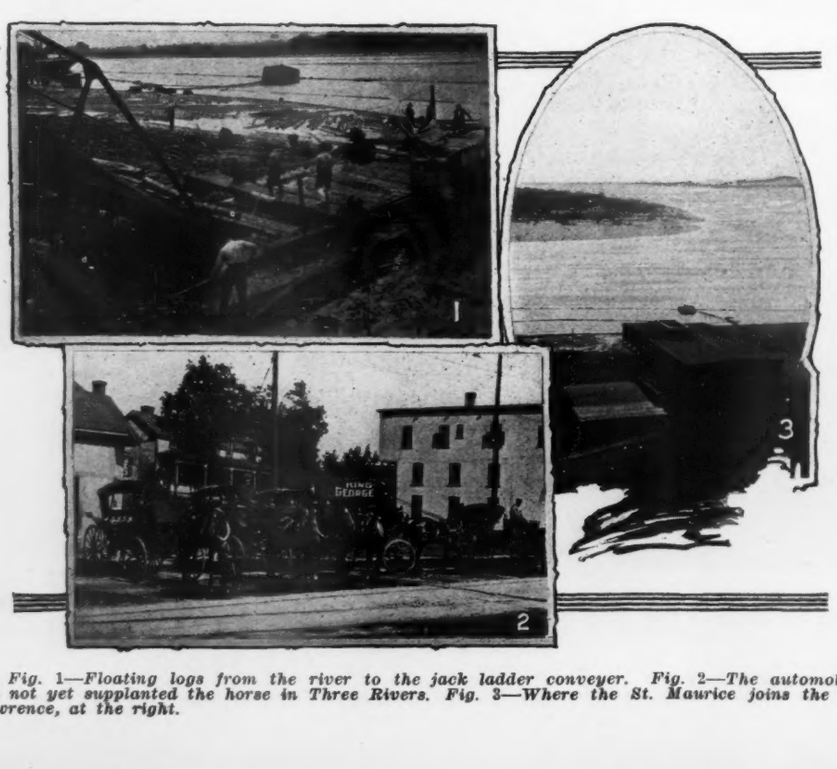
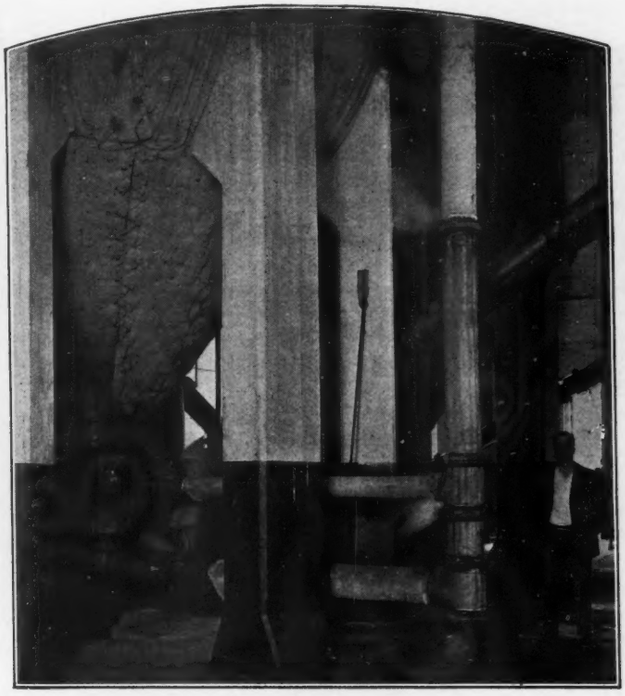


Fig. 1—Floating logs from the river to the jack ladder conveyer. Fig. 2—The automobile has not yet supplanted the horse in Three Rivers. Fig. 3—Where the St. Maurice joins the St. Lawrence, at the right.

Water cooler by which the sulphurous gas is chilled. This gas is used to make the acid which is employed in digesting the chipped wood in the sulphite mill.



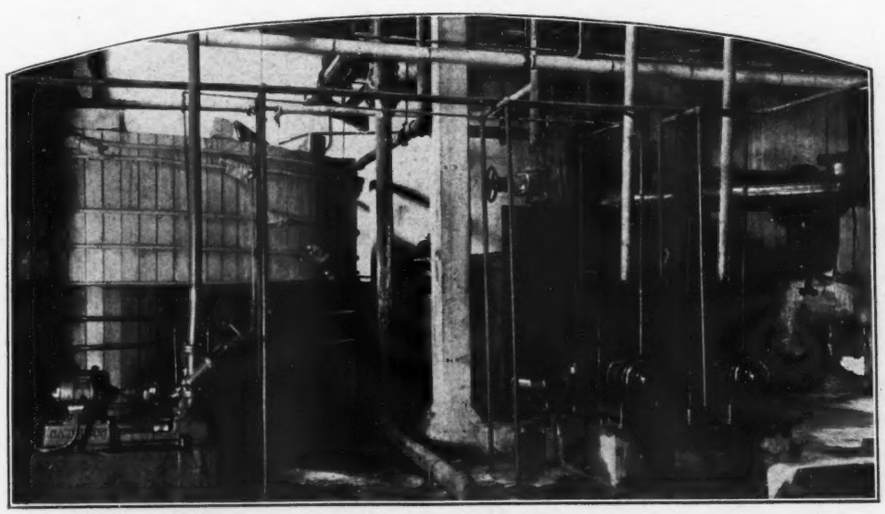
Discharge end of one of the capacious and towering digesters showing the connecting blowpipe. The sulphite pulp, when properly cooked, is conveyed from the digester to a great timber-lined tank or blow pit.

rolls of the press section and through the rolls of the calender. To do this by hand, with the machine running as fast as it does, would be extremely hazardous. In fact, it would be the height of folly to try to work a new sheet through a machine operating at a speed of more than 700 feet a minute.

The same serviceable medium is employed to cut one sheet before starting another one; compressed air is used to cool the calender rolls; compressed air shoots the paper from the calender rolls to the winding rolls; compressed air blows scrap paper from the machines and winders down to the beaters for reworking; and compressed air operates the doors in the floor at the wet end of the several machines by which "wet broke" is sent to bins in the cellar for reuse.

The final handling of the paper in the machine room consists in transferring the sheet from the winder roll to the splitting machine where the original roll is rewound and cut into rolls of suitable width for the printing presses of the ultimate consumer. Afterwards, these rolls are passed on to the shipping department where they are enveloped in wrapping paper, weighed, marked and loaded aboard the awaiting cars or carried to the near-by dock for water transportation.

The main compressor plant of the Three Rivers mill consists of two Canadian Ingersoll-Rand 16 and 10x12-inch machines of Type PLB-2. They are driven by electric motors at a speed of 225 revolutions a minute, and they maintain a pressure of 100 pounds. In conclusion we might point out that compressed air is employed extensively in the blacksmith shop and also in the machine shop, where it operates air drills, chippers and calkers, riveting hammers, etc. Compressed air likewise drives tools used in doing all sorts of repair work throughout the establishment; compressed air cools motors and bearings; and it is utilized to clean valves so that they can be closed tight and thus avoid the loss of considerable quantities of stock.



Acid tanks in the sulphite mill are built of 6-inch fir planking, and the acid is delivered to them and drawn from them by rotary pumps capable of handling the corrosive fluid.

CANADA ENJOYING GENERAL PROSPERITY

A STEADY resumption of building activity in the east and prospects of an early harvest in the western provinces are indications, reports *The Guaranty Survey*, of general prosperity and normal business in Canada. In spite of disastrous hail storms in Alberta and Saskatchewan, it is believed that the yield of wheat, oats, and barley will be above the average. Although farmers in the east are handicapped by a serious labor shortage, they, too, report favorable returns from their crops. Grain shipments from the port of Vancouver during the 1922-1923 season amounted to 18,860,000 bushels, or nearly three times the shipments of last year. Of this, 14,500,000 bushels went to Great Britain and the remainder to the Orient.

About 40,000 miles of wire was used last year in tying up the 400,000,000 sacks of cement produced.

Animal Life in America 10,000,000 Years Ago

The Badlands of Alberta Are Filled with Fossil Remains of Dinosaurs and Other Strange Creatures of the Distant Past

By A. S. TAYLOR

CALGARY is known to most people as the center of one of Canada's great wheat-producing areas—the source of the grain which is worked into the daily bread of thousands of people. How many are aware that this contributor to the vital present is close to the focal point of the biological past dating back 10,000,000 years or more?

Sweeping across the fruitful and far-flung prairies to the east of Calgary, the hastening traveler has nothing to remind him that but a comparatively few miles to the northward are the "Badlands" of the Red Deer River in which are preserved the bones of prehistoric creatures which bear mute evidence to the wonderwork of Nature in the ages before man appeared upon the earth. Scientists exploring the valley, cut by the Red Deer River and other erosive forces, have discovered a veritable treasure house of the skeletal remains of those terrible lizards, the dinosaurs, that flourished when the continent of North America was bound with that of Asia by a bridge of land where now flow the waters of Bering Strait.

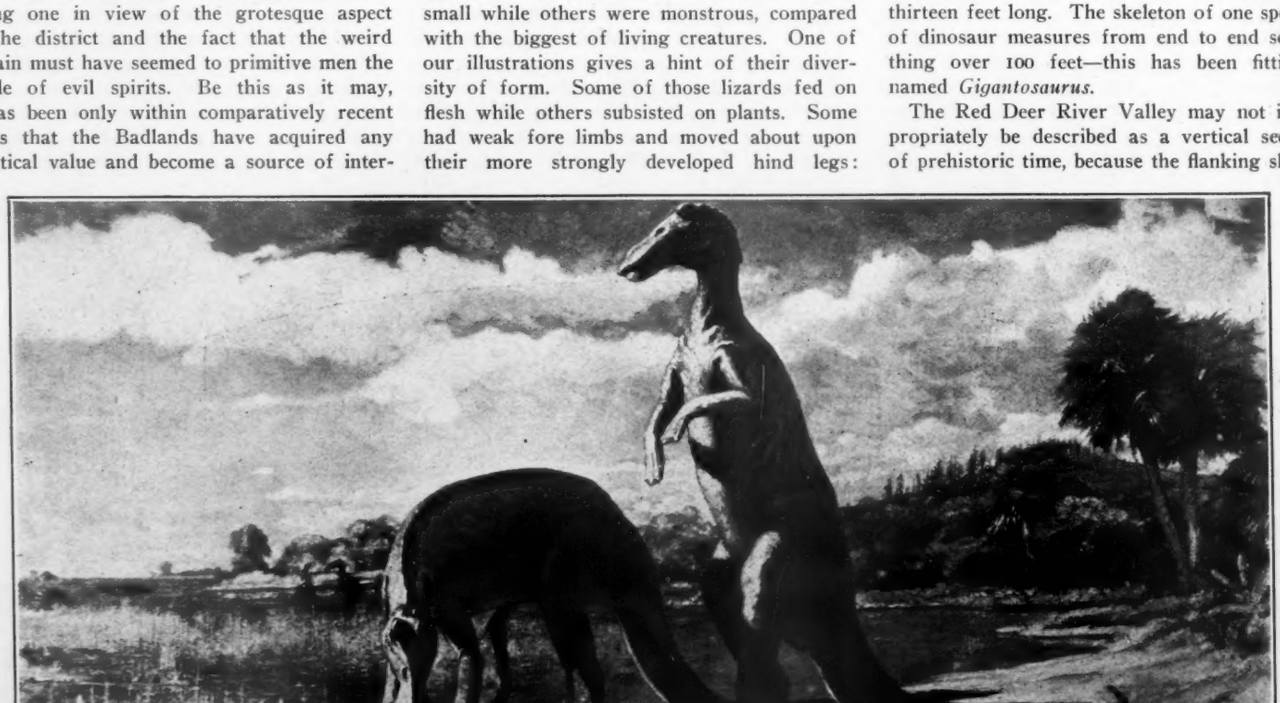
The Badlands of Alberta were so named by pioneer French-Canadian trappers who probably made use of a similar term employed earlier by the Indians; and the appellation is a fitting one in view of the grotesque aspect of the district and the fact that the weird terrain must have seemed to primitive men the abode of evil spirits. Be this as it may, it has been only within comparatively recent years that the Badlands have acquired any practical value and become a source of interest to those of us who are always gripped by revelations of what happened upon this globe of ours when animal life was struggling upward through vast periods of time.

The Rocky Mountains, which lie but a short distance to the east of the Badlands of the Red Deer Valley, are geological upstarts compared with the antiquity of the bones of the dinosaurs. Millions of years before the "Rockies" pushed their shoulders skyward, North America was split in twain from north to south by a body of water reaching from the Arctic Ocean downward to the Gulf of Mexico, as we know these marine divisions today. And at different periods, this long inland sea was alternately salt and fresh agreeably to vertical movements of the underlying earth which either cut off or opened up communication with the outlying oceanic tides. At one age, estimated by scientists to have been about 10,000,000 years ago, the section of the continent now traversed by the Rocky Mountains was largely made up of a region of lakes and rivers and land covered with a dense and rank vegetation. Then it was that a strange race of reptiles represented the climax of animal life.

Those dinosaurs were of widely different types and sizes. Some of them were extremely small while others were monstrous, compared with the biggest of living creatures. One of our illustrations gives a hint of their diversity of form. Some of those lizards fed on flesh while others subsisted on plants. Some had weak fore limbs and moved about upon their more strongly developed hind legs: others walked on all four feet Some were bird-footed and some had the typical feet of reptiles. The toes of some of them terminated in long sharp claws, and still others were equipped with flattened hoof-like nails. Some of the dinosaurs were big and ponderous, and awkward in their movements; and there is ample evidence that others were light and graceful and so modeled that their bones might be mistaken for those of birds by anyone not skilled in the anatomy of prehistoric creatures. Other differences might be mentioned, but space forbids.

The crocodile and the alligator are the largest surviving reminders of what were the kinds of animals which inhabited much of our present continent in the dim past; and the Badlands of Alberta disclose how, in succeeding periods of geological time, the dinosaurs underwent radical alterations in shape and physical characteristics as the climate and the conditions under which they existed changed. This story is plainly recorded in succeeding strata of the Red Deer River Valley—the earlier forms being buried in the lower or lowest of these enveloping beds of earth or rock. The largest of these animals dwarfed the elephant as we know that huge pachyderm, which is big when it is eight feet high and thirteen feet long. The skeleton of one species of dinosaur measures from end to end something over 100 feet—this has been fittingly named *Gigantosaurus.*

The Red Deer River Valley may not inappropriately be described as a vertical section of prehistoric time, because the flanking slopes



Duck-billed dinosaurs as they are supposed to have been in far-away ages. This restoration was made by Mr. Charles R. Knight, under the direction of Prof. Henry F. Osborn of the American Museum of Natural History.

of the valley cut through sedimentary layers of sand, gravel, clay, and sandstone deposited at different geological epochs by the invading sea and succeeding or intervening bodies of fresh water. Just how the animals were caught in the ooze or silt and embedded before the air could set up decomposition is still a subject for speculation and dispute; but it is evident that the engulfing must in many cases have been overwhelmingly sudden, inasmuch as the encasing sandstone has in numerous instances preserved a lasting impress of the hide or the skin texture of some of these early denizens of this hemisphere.

A man must, indeed, be phlegmatic that is not stirred by the visible story of the ages gone as it is written by these bony, petrified relics of a time when gigantic reptiles dominated much of the world and lived under conditions which, in all probability, could not have been endured by man at any period in his existence as far as our knowledge goes. The value of fossil deposits as a key to what went on eons ago and as a means to settling moot questions in the life history of the earth has been impressively emphasized by recent discoveries made in the heart of Asia, on the Mongolian plains, by an expedition sent there by the American Museum of Natural History. The scientists of that organization have found in the fossil beds of the Mongolian plateau not only evidence that the dinosaurs of America originated in Asia and crossed from Asia to America by a once-existant isthmus, but that those creatures were hatched from eggs laid in nests much after the manner in which crocodiles and alligators now beget their young.

It is hard for us, who believe in the permanency of the "everlasting hills," to grasp the fact that rivers and mountains have their day and do not endure forever. To most of us, the Rocky Mountains are a symbol of solidity and the survival of ages through which storms and the changing seasons have worn away the less resistant lowlands. It seems utterly contradictory that this towering barrier range should be a newcomer geologically compared with the Badlands to the eastward, both in Canada and the United States, that are so rich in fossil records of creature life covering a time anywhere from 5,000,000 to 10,000,000 years ago. But it so happens that the earth's crust adjusts itself agreeably to its specific gravity much like a floating body rests more or less exposed upon the surface of the sustaining medium; and probably the ultimate dead weight of the silt-formed Badlands carried them downward as the lighter mass of the mountains to the westward was shoved upward.

To the geologist, the Badlands, with their succeeding strata and their enveloped fossils, are a book of fascinating revelations, and to the layman the same regions offer a source of wonderment and instruction. Much has been written about the dinosaurs, and enough has been discovered in the way of facts to make it possible for the paleontologist to reconstruct not only the fleshy substance of these often grotesque animals but to visualize the general nature of the vegetation and the habitats amid which they flourished. There is ample proof that some of them had to fight for a living, and Nature, as has always been her wont, provided them with unique powers of offense and defense. Similarly, as the circumstances of their existence were tempered or made easier, so, too, was their physical get-up altered in order that they might accommodate themselves to their less hard or hazardous environment.

Courtesy, American Museum of Natural History.

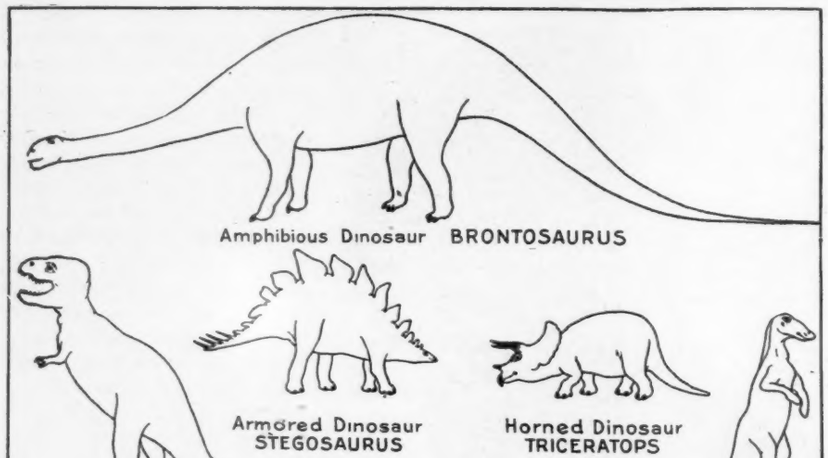
Skull of a duck-billed dinosaur from Alberta. The dinosaurs were not highbrows despite their imposing domes but possessed small brains of the type now found in crocodiles.

Strange as it may seem, the camel undoubtedly originated in North America, and the primitive ancestors of this beast, which is now a stranger to this continent, were developed well toward the modern camel before conditions of life here compelled it to migrate to other parts of the world. Perhaps the llama of South America reached its present home by way of the Isthmus of Panama, and maybe the camel of Asia migrated westward from America over the same neck of land by which the dinosaurs, traveling eastward millions of years earlier, found an agreeable abiding place on this side of the Pacific.

The Canadian Pacific Railway has issued an interesting folder describing the dinosaur remains of the Red Deer River Valley; and in this attractive publication it tells us that bones of the dinosaurs were first reported in that valley along about 1884 by a government surveyor, Mr. J. B. Tyrell. As far back as 1897 the late Lawrence M. Lambe, of the Geological Survey of Canada, was actively engaged in collecting vertebrate fossils in this field. The first serious expedition into the Badlands, however, was made in the summer of 1910 by Mr. Barnum Brown under the direction of Prof. Henry F. Osborn, of the American Museum of Natural History, New York. Since that date expeditions have been sent into the valley each summer; and the explorers have uniformly returned after achieving notable results. The American Museum, the Geological Survey at Ottawa, the Royal Ontario Museum, Toronto, and, later, the University of Alberta have all sent out exploring parties equipped for the very tedious and difficult work of removing the specimens from the rock in which they are embedded. These parties are rendering great service to science, for specimens once exposed are soon shattered and lost, while every specimen saved

Courtesy, Geological Survey, Dept. of Mines, Ottawa.

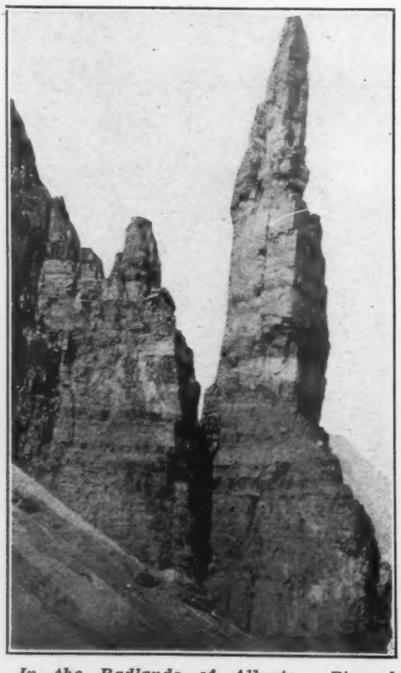
Digging out a 30-foot skeleton of a Gorgosaurus. The bones were taken out in five sections, and the largest of these weighed more than a ton.



The physical get-up of the dinosaurs varied widely agreeably to their habitats and to the conditions under which they existed at different periods of the earth. The sizes of these weird creatures are indicated by comparison with the dotlike figure of a man.

is an acquisition to the stores of human knowledge.

In the main, in the past, the recovery of most of the fossils has been accomplished with the pick and the shovel, but latterly methods more akin to up-to-date quarrying have been employed, utilizing in some cases the sculptor's tools to clear away the enveloping sandstone without fracturing the fossilized bones. As this work goes on—and there is no doubt about its continuance, it would seem highly desirable to utilize pneumatic tools supplied with motive power from conveniently placed portable compressors. It is not hard to picture how facilities of this sort would lighten the labors of the scientists, speed up operations, and make it practicable to remove the skeletons with the least likelihood of damage the while.



In the Badlands of Alberta. Pinnacle rocks showing the effects of eons of erosion.

TO SLAUGHTER THOUSANDS OF BUFFALOS

THE extinction of the buffalo was prophesied just a few years ago, but protective measures since have saved the American bison from this fate. Proof of this is the increase of the herd of buffaloes in Canada's great National Park from a few hundred to quite 8,000 animals.

In order to get rid of the excess, 2,000 of the bison were slaughtered last month after a big round-up which culminated in a spectacle replete with typical wild-west features. In the climax, several hundred Cree Indians participated, together with Canadian rangers and hunters. The occasion was made the most of by movie men who filmed the unusual picture.

KRAFT-PULP MILL TO BE BUILT IN CANADA

AS PART of an agreement with the provincial government of Ontario for certain timber rights, an American concern is to build and to operate a kraft-pulp mill with a minimum daily capacity of 75 tons. The plant is to cost at least $1,500,000. One-third of the construction is to be completed by June 1, 1924, and the plant is to be in operation one year later. The government reserves the right to require also the erection of a kraft-paper mill with a minimum capacity of 50 tons per day.

The manufacture of kraft pulp will be a new development in this community, and will bring into use a wider variety of woods than has been the case previously in the local paper industry. The success of this installation may bring about further developments in the production of kraft pulp and paper in Canada.

JOHN CUYAS

JOHN CUYAS, Chairman of Compañia Ingersoll-Rand, of Spain, died at an advanced age in Barcelona on the 16th of September, last. Mr. Cuyas was well known because of his connection, nearly all his life, with the Ingersoll Rock Drill Company, later The Ingersoll-Sergeant Drill Company, and, at the time of his death, the Ingersoll-Rand Company.

It was way back, about the year 1880, that he was employed as secretary in the office of the Ingersoll Rock Drill Company, at 1½ Park Place, New York City. At that time, Mr. José F. de Navarro, known as the richest Spaniard in America, owned a controlling interest in the Company—Mr. Cuyas being his representative in the office. He was so diligent, such a great worker, and a man of such high character, that he held his position through the several changes of ownership and management. As the business grew, the work became largely a matter of engineering, and, as he was not an engineer by training, he withdrew from the Company for a short period to enter the commission house of J. M. Ceballos & Company, of New York. Returning after a few years, he became a valuable assistant to the management when the office was located in the Havemeyer Building, New York City.

He was a Spaniard by birth, speaking and writing English as well as any cultured American. When the war broke out with Spain his sensitive nature induced him to ask to be transferred to Mexico, where he represented The Ingersoll-Sergeant Drill Company for a number of years. When the merger with the Rand Drill Company took place, Mr. Cuyas went into partnership with V. M. Braschi, in Mexico City, where for several years he represented the interests of the Ingersoll-Rand Company. When business in Mexico was practically destroyed by the revolutions, Cuyas was transferred to Spain—locating the office of the Ingersoll-Rand Company in Madrid, where, through his able management, a substantial business was built up.

In point of service he was one of the oldest employees of the Company, always loyal to its interests, truthful, and conscientious in the extreme, holding at all times the respect and good will of his associates and customers. His passing away is lamented over a wide field in America and Europe, for he was:

"Of manners gentle, of affections mild,
In wit a man, simplicity a child."

W. L. S.

FUR FARMING IN CANADA

THE total number of fur farms in Canada in 1922 was 1,009—comprising 960 fox, 17 raccoon, 13 mink, 3 skunk, 1 marten, 1 fisher, 4 karakul sheep, 5 beaver, and 5 muskrat farms. Compared with 1921, this is an increase of 185 farms. The fur production for the 1921-1922 season showed the output to have been 72 per cent. greater in value and 48 per cent. greater in number of pelts than that for the previous twelvemonth.

St. John Seeking Preeminence as a Winter Port

Improvements Already Completed and Others Contemplated Bid Fair to Make Her Canada's Principal Eastern Marine Gateway During the Cold Months

By H. G. EVANS

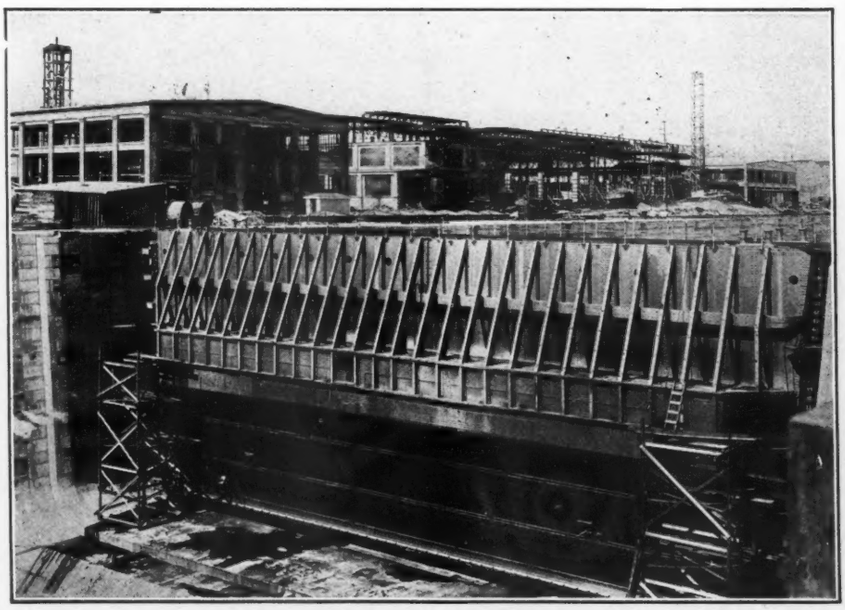
THE CITY of St. John, situated at the mouth of beautiful St. John River where it empties into the Bay of Fundy, has great possibilities, only partly developed, as the winter port of Canada—possessing as it does a fine, well-protected and safe harbor, free from ice the year round. The people of this port are of the opinion that its merits are not sufficiently recognized by the government at Ottawa; and while they appreciate the recent improvements at Courtenay Bay in the shape of a dry dock, etc., which will be described later on in this article, they think that more extensive facilities should be provided to bring this port into the prominence that it justly deserves as the winter gateway of Canada.

St. John lies 84 miles nearer Liverpool than Portland, Me.; and it is a well-known fact among railroadmen that through traffic, such as grain, can be hauled to St. John over the Transcontinental Railway—with its fine roadbed and low grades—as cheap, if not cheaper than it can be delivered to any other all-year-round port on the Atlantic seaboard if proper engines and equipment are put in service. A superficial inspection of the geographical situation might make this statement seem absurd, but a closer analysis will prove it to be true. From Quebec to St. John via the Transcontinental is 516 miles. From Montreal to Portland by way of the Grand Trunk is 297 miles. This shows a saving of 219 miles in favor of the Portland route. On the other hand, the distance from Winnipeg to Quebec via the Transcontinental is 100 miles shorter than the journey from Winnipeg to Montreal by way of the Canadian Pacific Railway—thus reducing the difference to 119 miles. This is a negligible quantity, and is more than offset by the good roadbed and the low grades on the Transcontinental, which are only $^{9}/_{10}$ of 1 per cent., compensated for curves, as against the heavy grades on the Grand Trunk, built 70 years ago.

While Mr. W. U. Appleton, General Superintendent of the Atlantic Region of the Canadian National Railways, was reading his interesting paper, entitled *Locomotive Freight Tonnage Ratings*, before the Maritime Meeting of The Engineering Institute of Canada, on September 27 last, he digressed from his subject to compliment the engineering fraternity as a whole on the really wonderful manner in which the roadbed of the Transcontinental had been laid down, and stated that the curves on grades had been so carefully compensated for that dynamometer tests of train loads on that section had shown that trains could run for miles on end, up grades and around curves, without any fluctuation in the drawbar pull.

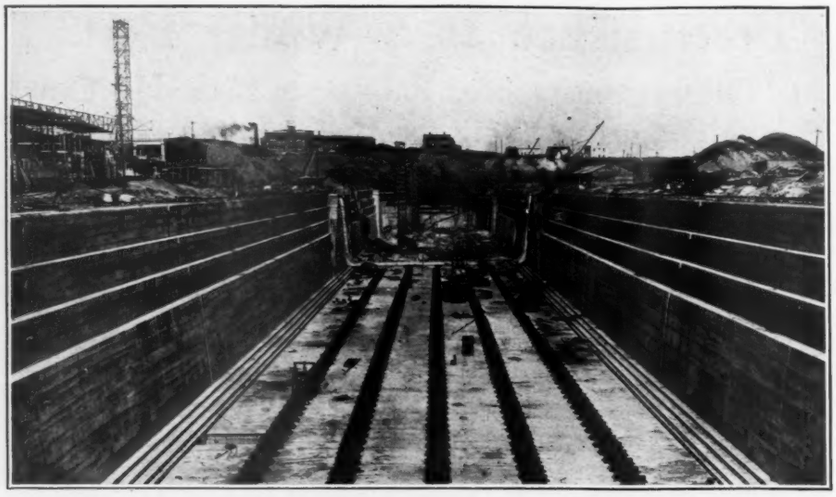
View of entrance to the dock taken just before cutting through the cofferdam which served as a protection during construction.

The diversion of the Transcontinental traffic, however, from American ports to St. John, entails the installation of greater facilities for transhipping; and the citizens of New Brunswick and of St. John believe this should be done as a matter of national policy. One great stride towards this end has been made by the opening of the St. John dry dock, which formal event took place on October 29 of this year. This work, which was started in 1910, proceeded very slowly for some time and almost ceased during the war, but in 1918 the job was taken over by the St. John Dry Dock & Shipbuilding Company, under the able management of F. M. Ross and the expert direction of E. G. Cameron, the chief engineer, to whom we are indebted for the illustrations accompanying this article and for the data in reference to the dry-dock equipment. These gentlemen cannot be commended too highly for the energetic and efficient manner in which they have prosecuted this work to its conclusion.



Close-up of the outer floating caisson which seals the dock when it is to be pumped out. This caisson or gate is equipped with electrically operated unwatering pumps.

The magnitude of the undertaking can better be gaged when one is reminded that it is the largest and best-equipped dry dock on the Atlantic coast, in fact in the world, accommodating as it does the biggest ships afloat. The dock has a usable length of 1,150 feet, and is divided, by an inner sill, into separate docking chambers which are, respectively, 650 and 500 feet long. The width of the dock at the coping is 144 feet, and there are 42 feet of

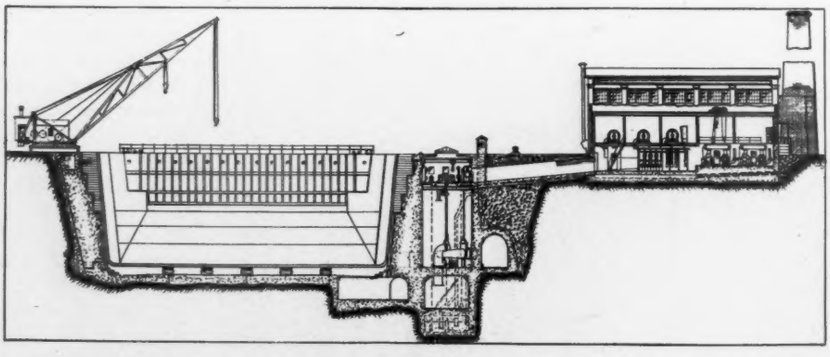


Interior of the dry dock as the structure appeared shortly before its completion.

water over the entrance sill at extreme high tide.

The unwatering of the dock presents a very nice hydraulic proposition—requiring as it does the discharge in four hours of 43,000,000 imperial gallons of water (an imperial gallon equals 1.2 U. S. gallons), which is taken care of by three centrifugal pumps, direct connected to two 750-H.P. Westinghouse vertical-type, self-starting, synchronous motors. These comprise the main pumping units. Two smaller centrifugal pumps, with 100-H.P. Westinghouse induction motors, are provided for drainage, and there is one sewerage type pump, driven by a 15-H.P. Westinghouse induction motor, for draining the sump. This combined sewerage and drainage system incorporated in the dock will accommodate all waste discharged from ships and obviates having to close them off when in dry dock, as has been the practice heretofore.

Power for the pumps and the repair shops



Cross section through dry dock and associate power plant and pumping equipment.

is provided by two 1,100-H.P., non-condensing, De Laval turbines and one 1,100-H.P. Wait, mixed-flow, condensing turbine, each directly connected to 1,100-H.P. Allis-Chalmers 550-volt, 60-cycle, alternating-current generators operating at 3,600 R.P.M. The boiler plant consists of four 500-H.P. water-tube boilers, which are equipped with Hammel oil-burning apparatus—installed by E. Leonard & Sons, Ltd. under the direction of the writer—that operate at 150 per cent. to 200 per cent. of boiler rating.

The air requirements are well taken care of by two 22x14x16-inch PRB-2, 2-stage compressors operating at 225 R.P.M. and driven by 300-H.P. synchronous motors. All the buildings are of reinforced-concrete construction, and contain the best and most up-to-date equipment for making ship repairs. A marine slip or railway dry dock—an adjunct to the main dock—is capable of handling vessels of 1,000 tons dead weight as well as smaller jobs that do not justify the use of the main dock.

The whole undertaking, exclusive of dredging the entrance channel—which has a minimum depth of 22 feet at low water, has cost $5,500,000, and was carried out by private Canadian capital under the terms of the Federal Dry-Dock Subsidies Act by which the Federal Government pays the company an annual subsidy of 4½ per cent. of the value of the dock for a period of 35 years. After that the company must operate without further assistance.

This dock will be very useful to the Great Lakes shipping trade, as the vessels in that service can now be docked and conditioned at St. John during the winter and then put to sea two or three weeks earlier than if this work were done on the Great Lakes. Thus they will be enabled to take a cargo to Europe and be back on this side of the Atlantic in time to enter the St. Lawrence as soon as navigation on that waterway opens.

If the reader will refer to a map of St. John harbor, it will be noted that Partridge Island at the mouth of the harbor, divides the entrance into east and west channels. The west channel is partially closed by Negro Point breakwater—extending from the mainland toward Partridge Island—which leaves a gap 1,500 feet wide between the end of the breakwater and the island. Under certain weather conditions, the ground swell enters here and causes disturbance in the lower end of the harbor, and while it is not dangerous to shipping the more exposed wharves are thereby inconvenienced during very pronounced southwest storms. Through this gap also comes a quantity of littoral drift, which is deposited in the channel and has to be dredged out. The government has decided to build a permanent breakwater across the opening not only to keep out the ground swell and the drift, but to form a roadway from the mainland to the island.

In this connection, Mr. Philip Brasher, of New York, submitted a very interesting proposition, namely, to close the gap, as it were, with a compressed air breakwater. Mr. Brasher visited St. John and spent considerable time on the project; and he decided that the conditions were ideal for an installation of his type as far as handling the seas were concerned. But unfortunately, the littoral drift and the roadway complicated the situation and caused the government engineers to decide against the Brasher system, although they were keenly interested in the proposition and may yet install it, when conditions warrant, on the east side of the island as a further protection.

Mr. Brasher's system, as designed to suit the prevailing conditions, consisted essentially of fifteen 4-inch pipes to be laid on the sea bottom and to extend across the gap, each pipe terminating in a 100-foot length of piping perforated every six inches by small holes. A power house was to be established on Partridge Island with three 500-foot steam-driven compressors and a battery of boilers, of 2,000 H. P. capacity, using fuel oil, which plant was to supply air at 22 pounds pressure. Compressed air pumped through the fifteen pipe lines, in ascending to the surface, would present a wall or curtain of air bubbles moving at right angles to the incoming waves.

Mr. Brasher's extensive study and experiments along this line have demonstrated clearly that a system of this kind will effectively retard the motion of a wave and cause it to break; for once the integrity of a wave is destroyed it simply ceases to exist and is no longer capable of doing damage. The operating costs of such a plant, including overhead and running charges, would be much lower than the fixed cost of a permanent breakwater; but, as previously mentioned, it was not merely a question of breaking the wave motion—otherwise the unique Brasher system would probably have been installed.

Canada's Great Asbestos Industry

The Dominion Now Supplies Fully 80 Per Cent. of all the Asbestos Consumed the World Over

By NORMAN R. FISHER*

THE NAME asbestos is the Anglicized form of a Greek word meaning unconsumable or indestructible, and has been applied to certain minerals of a peculiar fibrous character much like flax, cotton, grass or other organic substances. Asbestos has, in fact, so many physical properties in common with the vegetable kingdom that in early times it was actually looked upon as belonging to it—the opinion then being that it was an unburnable variety of vegetation that, in drying, had become indestructible by some strange action of Nature. When separated, it really looks like cotton, and can as readily be spun into yarn or woven into the finest fabric. It is, nevertheless, a mineral that has crystallized in a rather unique manner into long, flexible, silky filaments so like many organic substances in appearance that the layman may well be excused for mistaking its real character.

Asbestos is not a particular kind of mineral: on the contrary, there are many distinct varieties all differing in chemical composition but very much alike in physical properties; and of these the most important from a commercial point of view is the variety known as chrysotile. Chrysotile is a hydrous silicate of magnesia, and contains, in addition, more or less impurities in the form of iron and aluminum. The presence of the latter element has apparently little effect on the quality of the asbestos. Iron, however, when present, affects it detrimentally in almost every respect in proportion to its quantity.

In its natural, solid state, chrysotile is highly lustrous and, in reflected light, shades from a beautiful light to dark green in color. But when separated into its constituent fibers, it looks for all the world like so much raw cotton, and is, therefore, so called in many districts. Chrysotile can be quite readily broken up either by hand or by machine; and the best quality will separate into threads so fine, flexible, cohesive, and strong that they can be spun into yarn that weighs less than half an ounce per hundred yards. Originally, asbestos was chiefly employed for making fireproof cloth, in fact one of its earliest known uses was to envelop corpses burned on the funeral pyre. In recent times its field of usefulness has so broadened with the general growth of industry that it is now employed in every conceivable direction where its heat, acid, electrical, and weather-resisting properties can be effectively utilized.

The longer-fibered grades suitable for spinning are now mostly used in the manufacture of brake linings, theater curtains, fire and acid-resisting cloths, electrical insulation, etc., while the shorter varieties are extensively employed in the engineering trades and in ever-increasing quantities, for almost every conceivable purpose from roof to cellar, in the construction and appointment of buildings. So great, in fact, has the demand for asbestos in this direction grown during the past decade that shipments of the shorter grades of fiber have more than doubled—with Canada, alone, supplying upwards of 150,000 tons annually.

Chrysotile is found at many different points throughout the world, but the most important deposits now being exploited are located in Canada and Rhodesia, with respective outputs in the ratio of about 10 to 1. In Canada, it is known to exist at numerous widely separated points, but the principal known sources are located in the Notre Dame Hills of the eastern townships in the Province of Quebec. Within a stretch of about 70 miles of these hills there are at present six important producing centers, generally designated as the East Broughton, the Robertson, the Thetford, the Black Lake, the Coleraine, and the Danville areas, and in each of these one or more mines are today being operated on a large scale.

The asbestos produced in each district, though all of the chrysotile variety, differs considerably in quality, but each grade has certain advantages for some particular manufacturing purpose. The most desirable grade for spinning, which requires length, strength, and flexibility, is for the most part found within the Thetford area; and it is generally conceded that the product obtained there is not only the finest of its kind in the Province of Quebec but is also superior to any now being mined in commercial quantity in other parts of the world.

*Consolidated Asbestos Limited, Province of Quebec.

Stoping in an asbestos mine with column-mounted drills.

The exploitation of the Quebec deposits commenced in 1878, at which time they became sufficiently accessible for the purpose as a result of the construction of the Quebec Central Railroad. Only a few tons of asbestos, however, were shipped out in that year, and they served more for test purposes than anything else. These tests convinced the manufacturers of the outstanding quality of the Quebec product in comparison with that from Italy, which was then mostly used. In fact, so desirable did they find the properties of Canadian chrysotile for almost every purpose that the demand for it grew rapidly—increasing gradually from year to year until now it amounts to around 200,000 tons annually. Altogether, over 2,250,000 tons, of a shipping value of more than $100,000,000 has been produced since the inception of the industry.

In the early days, only the vein matter, known as crude, was recovered, and this was merely hand cobbed from the quarried rock and afterwards sorted into two or more grades, according to its length and quality. Later on, mechanical methods were evolved and put in service to extract what asbestos still remained in the rock after it had been dealt with by hand for its crude content. Milling is now carried on so extensively that there is today being treated in the neighborhood of 3,000,000 tons annually for an average recovery of around 6 per cent. of what is known as "mill fiber." In addition to this, much short material, such as asbestos sand and asbestic, is extracted, but only in such quantity as the somewhat limited and irregular market for it justifies.

SHIPMENTS OF ASBESTOS CRUDE AND FIBER FROM THE PROVINCE OF QUEBEC AND THEIR TOTAL AND AVERAGE VALUES.

Year	*Tonnage shipped*	*Total value*	*Average value per ton*
1878	70	5,250	$75.00
1879	300	19,500	65.00
1880	380	24,700	65.00
1881	540	35,100	65.00
1882	810	52,650	65.00
1883	955	68,750	72.00
1884	1,141	75,097	65.81
1885	2,440	142,441	58.37
1886	3,458	206,251	59.65
1887	4,619	226,976	49.55
1888	4,404	255,007	57.90
1889	6,113	426,554	69.77
1890	9,860	1,270,240	128.82
1891	9,279	999,878	107.75
1892	6,082	390,462	64.16
1893	6,331	310,156	48.99
1894	7,630	420,825	55.15
1895	8,756	368,175	42.04
1896	10,892	423,066	38.84
1897	13,202	399,528	30.26
1898	15,893	496,340	31.23
1899	15,571	581,667	37.36
1900	21,408	719,416	33.60
1901	33,466	1,274,315	38.70
1902	30,634	1,161,870	37.92
1903	29,261	916,970	31.94
1904	35,479	1,186,970	33.43
1905	48,960	1,476,450	30.16
1906	61,675	2,143,653	34.76
1907	61,985	2,455,919	39.62
1908	65,157	2,551,596	39.16
1909	64,965	2,296,584	35.35
1910	80,605	2,667,829	33.10
1911	102,224	3,026,306	29.60
1912	111,175	3,059,084	27.52
1913	136,609	3,830,504	28.04
1914	107,401	2,895,935	26.96
1915	113,115	3,544,362	31.34
1916	133,339	5,182,905	38.87
1917	137,242	7,198,558	52.45
1918	142,375	9,019,899	63.35
1919	135,862	10,932,289	80.47
1920	179,891	14,749,048	81.99
1921	87,475	5,199,789	59.44
1922	160,339	6,053,068	37.75
Total	2,209,368	100,741,932	$45.60

Though the industry has had its dull periods in the past, and will probably continue to have them during times of general depression, it has, nevertheless, forged ahead from year to year, as the accompanying table, which covers the annual shipments from the district since its inception, goes to show. That the industry will keep on developing and, at the same time, enjoy much more stable conditions in the future than in the past, is very apparent when one considers the ever-widening uses and broadening markets for asbestos products. Of all the asbestos now consumed in the world, Canada supplies about 80 per cent., the balance being mostly the product of Africa; and of the Dominion's output the greater part is exported to the United States, only about 20 per cent. going to Europe and elsewhere.

The chrysotile of the Quebec region exists at many widely separated points in an extensive mass of serpentine which forms part of a great belt of intrusive basic rock that stretches in a northeasterly direction for several hundred miles through the province. But the mineral is found in sufficient quantity, or under sufficiently advantageous circumstances to justify its exploitation, in only a comparatively limited area about 70 miles long and a mile or two wide.

It has not yet been definitely established how this igneous belt intruded the more ancient rocks that embrace it, but certain structural conditions surrounding it at various places along its strike point to the fact that it is in the form of a sill, some 2,000 feet thick, that was considerably folded after its intrusion and solidification.

The greater part of the serpentine of the belt is rather massive in character, and contains many acid inclusions of an aplitic substance colloquially known as granite, but there is another apparently quite distinct body, also of considerable economic importance, that is of a decidedly schistose nature and altogether free of acid inclusions of any sort. The latter is exposed for only about 14 miles and has a width of 300 feet at most. Compared with the main body of the serpentine, it is very limited in extent, but, even so, it includes several important mines—in fact those embraced by the East Broughton and Robertson centers. The smaller bed runs parallel with the main body for a short distance to the north, and, though both are supposed to be of the same age, their exact relationship is still a moot question inasmuch as there is no direct connection between the two and no positive geological evidence to serve as a guide.

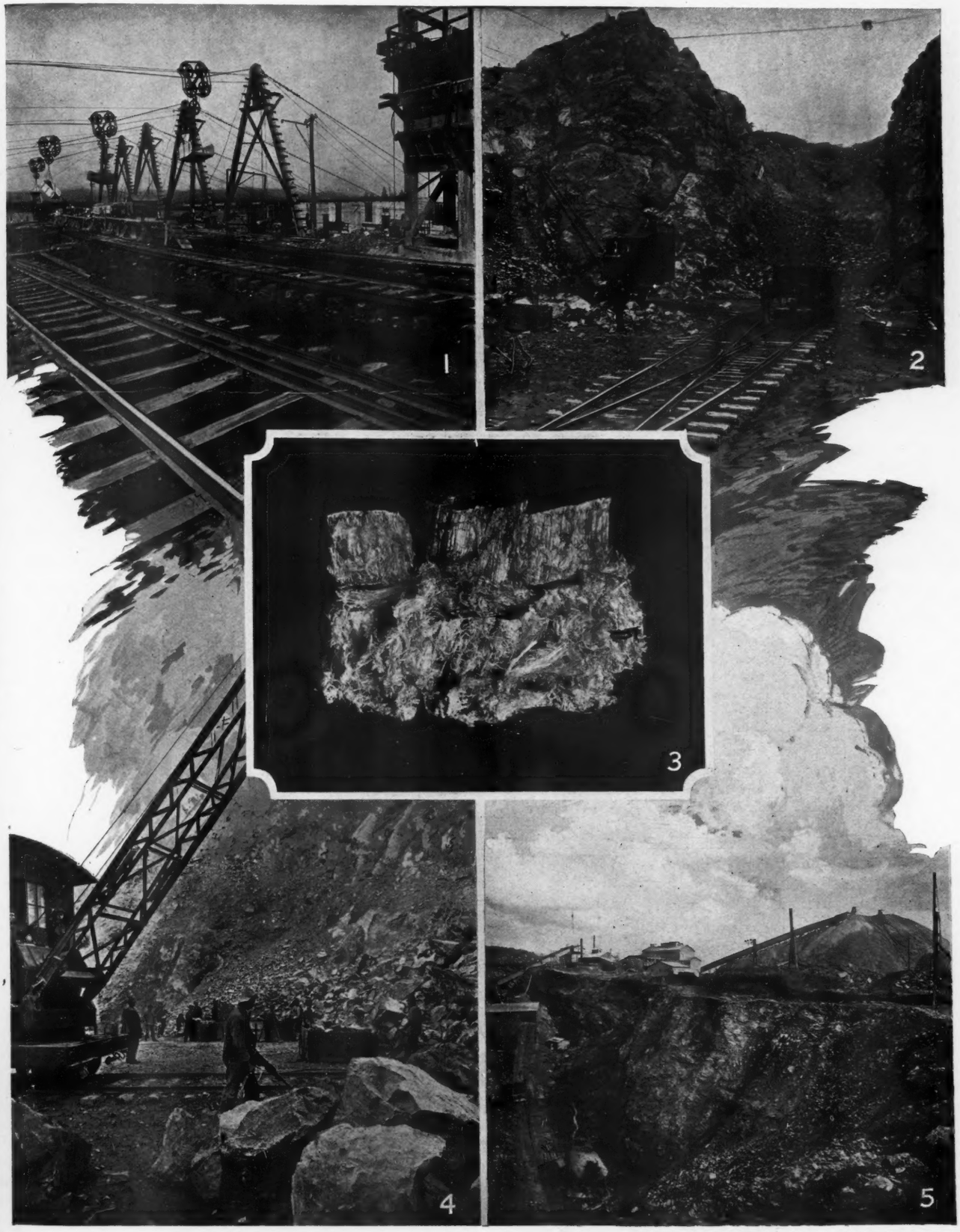
Besides its structural differences, the schistose deposit has several distinct physical characteristics by which it can be distinguished. For instance, it is much lighter in color and more talc-like to the touch than the general run of the serpentine, and contains most of its asbestos in the form known as "slip fiber" instead of the usual "cross fiber" of the main body. Slip fiber is the product of friction, and is found more or less parallel to the cleavage or shear planes of the serpentine of which it is an alteration product formed after the solidification of the main mass, whereas the cross-fiber variety is a product of solution that exists in the joint planes of the serpentine with which it was apparently formed contemporaneously.

The schistose, slip-fiber bearing serpentine is much more regular in its fiber content than the more massive cross-fiber bearing portion and, on the whole, carries a higher percentage of recoverable fiber. This is doubtless due to the fact that its asbestos content, as a result of the very general nature of its structural metamorphism, is disseminated in a more or less uniform manner throughout the mass. The content of the cross-fiber bearing variety is found, for the most part, in the form of veins which are either scattered throughout the mass or are closely associated in irregular networks or parallel systems that constitute enriched areas or zones. The intervening rock very often contains little or no asbestos at all, and is locally termed "dry rock." As there is an almost unlimited supply of the rock formation containing both kinds of fiber, there is, at present, sufficient asbestos in sight in the Quebec region to provide for the inroads of man for a very long time to come.

Both the slip and the cross-fiber varieties of asbestos are more or less alike in chemical composition but they differ considerably in their physical characteristics, as does the cross fiber itself, mined in different places.

Slip fiber is unusually white; quite soft and talc-like to the touch; and lower in tensile strength than the best of the cross-fiber variety, while the latter, though at times quite dark in color; harsh to the touch; and even brittle, is usually—especially in the Thetford area where the best quality is produced—just like silk in appearance and in texture, and exceptionally flexible, cohesive, and strong.

This variation in the quality of the cross-fiber asbestos is no doubt due, in some measure, to the circumstances under which it was originally formed, but, no doubt, mostly to the conditions under which it has subsequently existed. It is very susceptible to deterioration as induced by Nature. Even the partial reduction of its water of crystallization is known to materially



Courtesy, B. Marcus.

Fig. 1—Part of extensive cableway system by which the asbestos is handled at some mines. Fig. 2—Steam-shovel method which is also employed in distributing ore in open-cut operations. Fig. 3—Fine example of chrysotile asbestos from Thetford mines. Fig. 4—Block holing large pieces of rock with pneumatic drills. Fig. 5—From raw rock to tailings; a comprehensive view of the treatment of asbestos from mine to mill.

Traveling-crane method of handling asbestos when mined in open pits.

Putting in 16-foot lifters with a CI-R No. 78 drill.

affect it physically to its detriment. As this content, which amounts to about 14 per cent., is decreased the harsher, the more brittle, and the weaker in tensile strength the asbestos gradually becomes. It is given off very slowly up to around 850°F., but thereafter the water of crystallization is dissipated readily. Its fusion point is in the neighborhood of 2,800°F.

All the deposits of asbestos now being mined in the province outcropped as pay ore, and were consequently first attacked directly at the surface by an open-cut method of mining. In some instances it was possible to work the deposits for a time by quarrying right into the sides of the hills or prominences, but more often it was found necessary to commence sinking at once and to carry on, in a small way, the same kind of open-cut mining now being conducted on a large scale at many properties. The pits in many places are several hundred feet in diameter and over 350 feet deep.

The open-cut methods naturally necessitate the removal of overburden before mining can begin, and as it runs in some cases up to 100 feet and more in depth this work represents quite an important item in the mining costs of some companies. Where the overburden, which is for the most part made up of glacial clay, is of sufficient quantity and deep enough to justify the initial outlay, steam shovels are used for its removal but where it is shallow it is usually disposed of by hand loading into either derrick boxes or horse-drawn wagons.

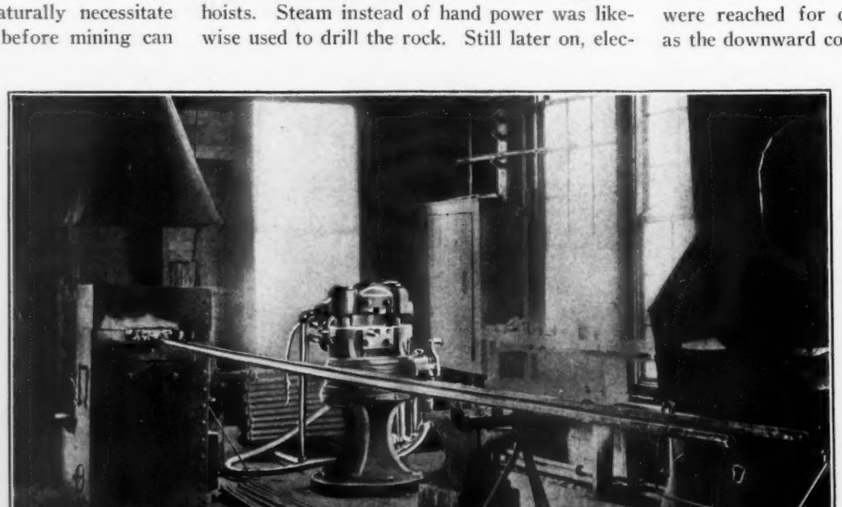
At the present time, several different systems of mining are practiced, and, for the purpose of this article, these may be divided, according to the method of disposal employed in each, into the following classes: the boom-derrick method; the cableway-derrick method; the traveling-crane method; and the underground method.

Except in the few instances where side-hill quarrying was practicable, the boom-derrick system of mining was the original one used, and it is even to this day resorted to in connection with any small undertaking. The ore, as broken, was first examined for its crude asbestos content; then hand loaded into boxes which were raised to the surface by the derricks; and next disposed of by the most convenient method available. The drilling was all done by hand; and the derricks were operated by horse whims or whips.

As the pits grew deeper, and it was necessary to handle a much greater tonnage than the primitive boom-derrick arrangements permitted, the latter were replaced by more suitable cableway-derricks provided with steam-power hoists. Steam instead of hand power was likewise used to drill the rock. Still later on, electric hoists and air-driven drills were for the most part substituted for the steam-power equipment, though in some instances the hoists were merely changed to air drive—the operating medium being supplied by large, electrically driven compressors in a central station.

In this particular method of mining, all broken rock within the range of a derrick was, as before, loaded by hand into boxes of from 1 to 1½ tons capacity; hauled to the surface; and then dumped into waiting cars, bins or pan conveyers, as the case might be. Naturally, the cableway-derrick system necessitated the enlargement of the pits laterally once the practical operating limit crosswise had been reached by the derricks. This consequently called for the construction of additional derricks from time to time until, in some cases, as many as ten or more of them paralleled one great opening.

However, as the lateral limits of these pits were reached for one reason or another, and as the downward converging walls rendered the further use of existing equipment impracticable, other methods of attack had to be developed. At some mines merely an elaboration of the cableway-derrick system was adopted, and this was provided with equipment of sufficient size and strength to permit the pits being both widened and deepened to the desired extent. In a particular instance where this course was pursued, one of the most elaborate installations of the kind in existence was put in service with derricks having a span of about 1,000 feet and boxes having a capacity of five tons each. The company now operates six such derricks, and these can together handle, under



The "Leyner" sharpener is a feature of all well-equipped blacksmith shops in the asbestos-mining industry.

"Little Tugger" hoists are widely used for switching cars in asbestos mines.

ideal working conditions and with sufficient loaders available, upwards of 300 tons an hour.

At other properties, however, where the hand-loading method is preferred, a less elaborate but in many respects a more efficient system of dealing with the boxes was subsequently adopted in the shape of traveling cranes operating on the pit bottom. Again, the boxes are all filled by hand; but in this case they are lifted by cranes instead of derricks and are dumped into large-capacity cars, conveniently placed for the purpose by engines which then move the loaded cars to the bottom of an incline haulageway through which they are brought to the surface.

This means of disposal is undoubtedly the simplest and the cheapest one at present in use for this particular kind of mining, which involves putting the broken rock into boxes by hand, but it must naturally cost more than those that permit the loading to be done by gravity or by mechanical methods. However, its advocates contend that any extra expense thus incurred is offset by the cleaner recovery of crude, not to mention the more thorough separation of the barren or dry rock made possible. In some mines this amounts to over 50 per cent. of the total rock quarried.

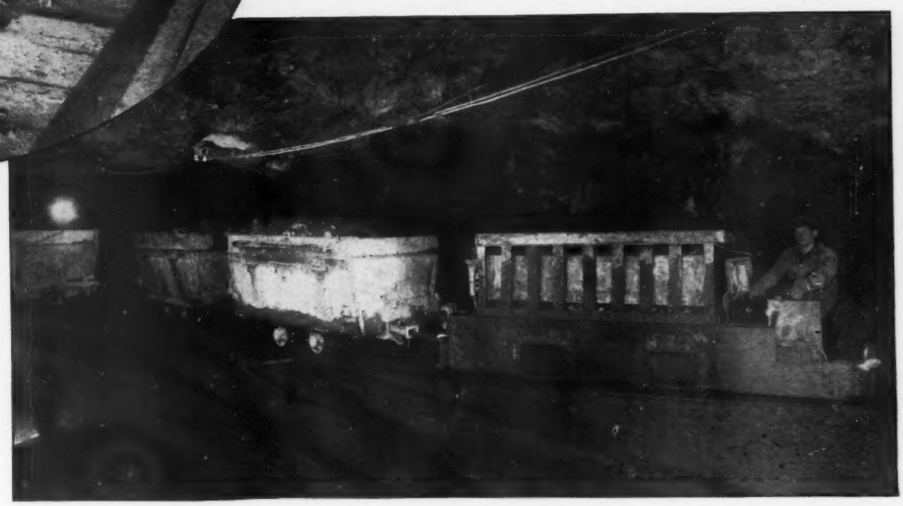
At other properties the extraction of the crude and the removal of the barren rock, as described, is either deemed unnecessary or is not looked upon with favor. Instead, the broken rock is mechanically excavated and delivered directly into cars by means of steam shovels.

This practice is undoubtedly the cheapest from the point of view of cost per ton, and will in all likelihood be generally adopted some day throughout the field wherever operating conditions will permit. In the slip-fiber section of the serpentine belt it is already universally used.

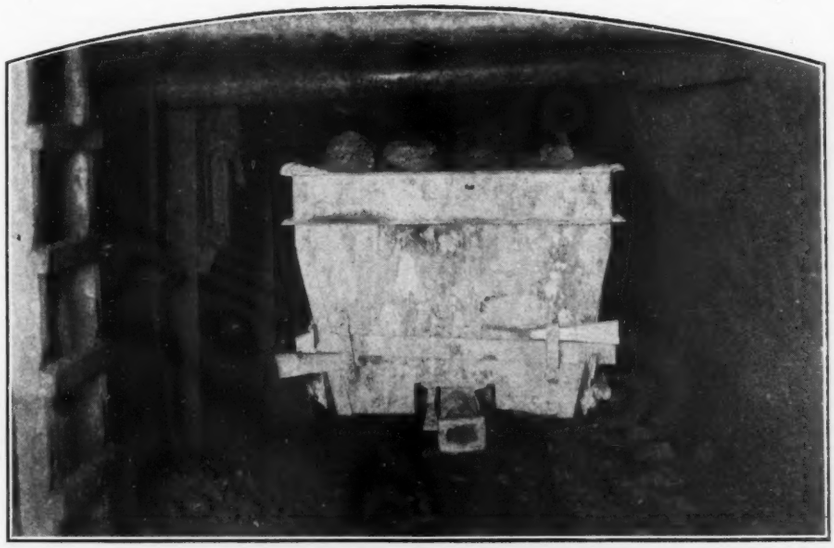
There are many different types and sizes of shovels in service because of the varied conditions under which they must operate. The choice is necessarily governed as much by the class of rock as by the amount of material to be handled by them at each load. In the massive serpentine, where the rock is hard and breaks into fairly large pieces, very heavy shovels, equipped with large dimension buckets, are used in order to reduce the amount of block holing that would otherwise be needful, whereas in the slip-fiber section, where the rock is ideal for mechanical shoveling, a much lighter type of machine, equipped with 1 to 1½-yard buckets, proves quite satisfactory. The sturdier shovel is generally designed for ordinary railroad traction, while that of lighter make is preferably of the caterpillar type. All the shovels now in the field are operated by steam power, but undoubtedly many will be replaced, as time goes on and opportunity offers, by electric drive.

Again, at certain other properties, underground methods of mining and ore disposal have been adopted. The deposits have been developed from adits and vertical or inclined shafts by elaborate systems of tunneling—extending, in one instance, for several miles—and the ore is mined either by stoping underground or by "glory-holing" at the surface.

At one particular property, where this method is practiced on a large scale, raises are run to the surface at certain points conveniently located in the glory hole, and, after any overburden in their vicinity has been disposed of through them, all the ore within their reach is broken down into them and drawn through capacious chutes into 5-ton cars stationed at the level below. Elsewhere in the workings, where conditions are sufficiently favorable for stoping, long, 35-foot-wide shrinkage stopes have been developed. These stopes are parallel, and have 40-foot pillars between them. No timbering is employed other than that required for the chutes, inasmuch as horizontal pillars, about fifteen feet thick and pierced approximately every twenty feet for the chutes, are left above the drifts. As these stopes break through to the surface they automatically become great, elongated



Hauling asbestos in a mine by means of a storage-battery locomotive.



Loading cars from an underground chute.

Carrying on cobbing operations in an underground stope.

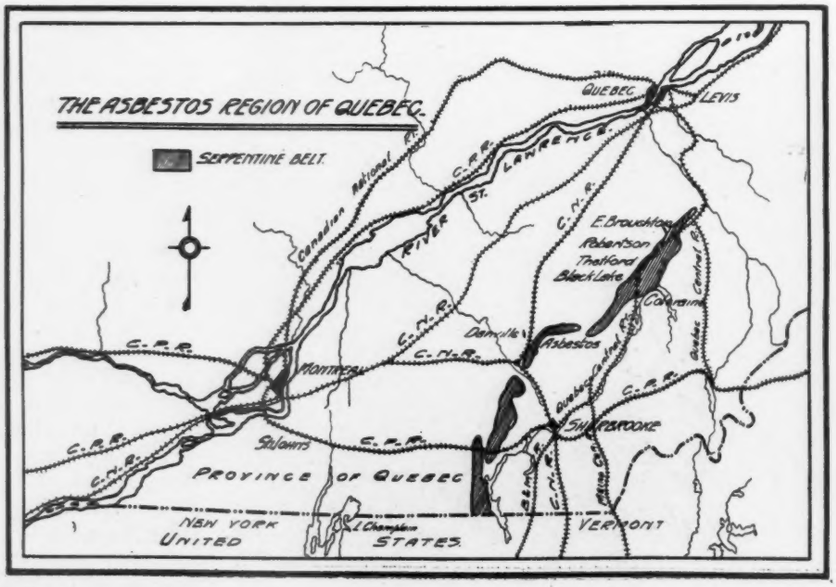
glory holes, into which the dividing walls or pillars are broken from the surface downward.

The loaded cars, designed to handle twenty tons of broken rock at a time, are delivered to either the vertical or the inclined-shaft stations by storage-battery locomotives. Large storage pockets are provided at the vertical shaft, which is equipped with 4-ton, self-dumping skips. The incline haulageway, which has a grade of 1 in 3, is double tracked, and provides another outlet for the ore and, at the same time, a convenient passage direct to the dump for all the overburden and barren rock accumulated during the mining operations.

The glory-hole method of mining has many obvious advantages over the various open-cut systems, and one of the most important of these is that it can be carried on, without interruption, during any kind of weather. This is a very vital factor in a climate such as prevails in Canada. Moreover, it makes it possible to provide a considerable reserve of broken ore so as to regulate the output, and it also enables selective mining to be practiced in order to control the grade treated.

All the broken rock, both from the glory hole and from stope workings, is hand picked and cobbed for its crude content after each blast; but, naturally, the extraction at this point cannot be as clean as that where open-cut methods are followed, by which every ounce of rock is carefully handled and examined. This disadvantage, however, is more than made up later on by passing all the broken ore, as it comes from the primary crushers, over a system of picking belts, where it is subjected to close scrutiny for what crude remains and, at the same time, for the disposal of barren or dry rock.

(To be concluded.)



CANADA'S COAL TRADE

THE OUTPUT of the Canadian coal mines during the first six months of 1923 amounted to 8,722,205 gross tons, of which the Province of Alberta produced 3,312,991 tons and Nova Scotia 3,613,339 tons, according to the Dominion Bureau of Statistics. During the same period in 1922 the output was 6,205,288 tons—Alberta and Nova Scotia yielding 2,258,296 tons and 2,336,261 tons, respectively. Production during 1923 consisted of bituminous coal and lignite, whereas 35,145 tons of anthracite were included in the output for the first six months of 1922.

Exports of coal during the six months ended June 30, 1923, totaled 1,014,763 tons against 605,423 tons in the corresponding period of 1922, while the imports of coal from the United States during the first half of 1922 amounted to 5,114,036 tons as compared with 9,967,021 tons for the first half of the current year. Great Britain supplied but 235,829 tons from January to June, 1923, and none during the same period of 1922.

Having no native coal, and being far removed from the supplies in eastern and western provinces, central Canada, comprising the northwestern part of Ontario and practically all the Province of Quebec, assumes the lead in coal imports. Of the 2,691,862 tons of anthracite imported during the first half of this year, 2,623,032 tons were received by that area; and of the 7,510,988 tons of bituminous coal imported 6,510,078 tons went to central Canada.

The Canadian National Railroads have agreed to ship from the Province of Alberta, 10,000 tons of coal, at a rate of $7 per ton as compared with the former rate of $9, upon the condition that it is taken from the Alberta mines by October 31. This reduction will make it possible for consumers in Ontario to receive coal for about $13 per ton. The coal is to be distributed by the Province of Ontario to such dealers and municipalities as make application; and the province will order only a sufficient quantity to fill requisitions from these two sources.

BLACK RAIN

AT Port Arthur, Tex., there fell recently a heavy, black rain as the result of the burning of an earthen oil tank. The tank, having a capacity of about 250,000 barrels, was fired by lightning and burned for several days—boiling over and setting fire to buildings nearby. In consequence, a blanket of smoke hung over the city; and, a heavy rain falling at the time, the cisterns of the town were filled with water black as ink. Truck growers reported that muskmellons and cucumbers died as though burned, and hardier plants, which survived, looked as if they had been painted.

Pumping Water by Compressed Air in Winnipeg

By S. J. MATHEWSON, JR.

THERE ARE many industries in which a constant supply of pure, cold water is an economy if not an absolute necessity. In the City of Winnipeg, Man., the water in the mains has an average temperature of about 70°F. for several months of the year, and for that reason plants requiring a steady flow of clean, cold water for one purpose or another have had to secure their supply from another source—namely, from Artesian wells. At first, the water from these wells was pumped by means of steam-operated, deep-well plunger pumps; but as both the static head and the pumping head vary considerably in different districts in the city, it was very difficult to determine beforehand the correct size of pump that would be needed.

About ten years ago the first air-lift was introduced, and it at once found favor owing to the low operating costs and the flexibility of the unit. This means of pumping water has become so popular that at the present time practically every packing house, dairy, cold-storage plant, ice-cream plant, brewery, etc., has installed an air-lift system. The air-lift pumping plants in Winnipeg range all the way from those operated by small vertical compressors to the installation at the Union Stock Yards, where an Ingersoll-Rand 16 and 10x14-inch, Type 10, 2-stage compressor is at work.

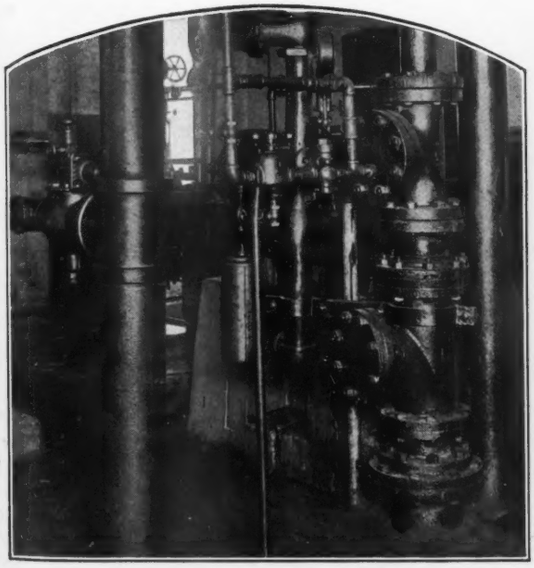
Two of the accompanying illustrations show the very simple arrangement of the air-lift system at the Crescent Creamery Company's ice-cream plant at Winnipeg. This plant was using city water, and when it was decided to supply Artesian water the well had to be drilled outside the building. This well is 10 inches in diameter and 350 feet deep; and the system consists of an Ingersoll-Rand, class VC air-lift pump with a 4½-inch water discharge pipe and a 1½-inch air pipe; of an 8x8-inch ER-1 compressor with short belt drive; of an air receiver, and of a Cameron No. 2½ DV pump.

The compressor, the air receiver, and the circulating pump were placed in a convenient corner in the basement of the building, and the air was piped out through a window to the well. The water, in turn, was piped from the well to a large surge-tank in the basement, from where it was distributed throughout the plant by the circulating pump. It should be obvious that with this system of pumping there is nothing to wear out or to get out of order outside the building, and that it is not necessary to erect a shelter over the well. This is clearly shown in one of the illustrations. The total cost of this pumping plant, including the drilling, the well casing, and the installation of the machinery, was approximately $5,000. Allowing for operating costs, depreciation, interest on the investment, etc., the unit is effecting an annual saving of about $2,500; and, in addition to this saving, the capacity of the plant has been increased about 15 per cent.

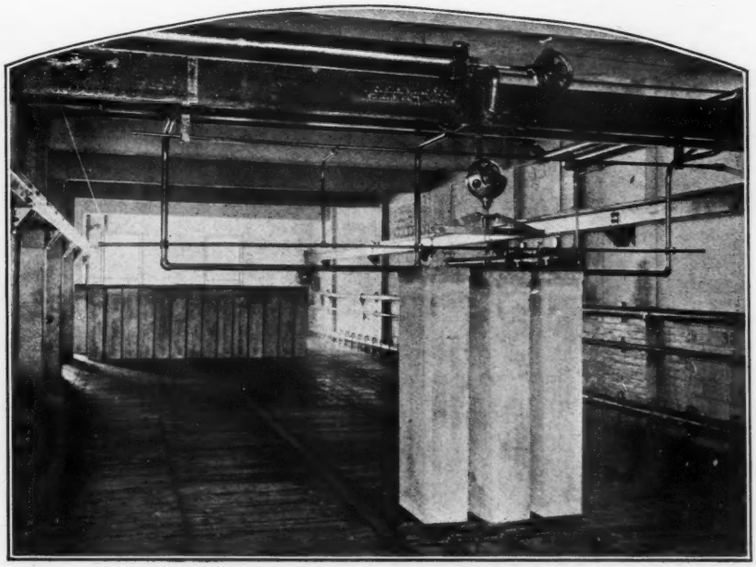
Another very simple adaptation of the air-lift system is that employed by the Arctic Ice Company at their new artificial-ice plant at Winnipeg. Here the well was dug before the buildings were erected. This well is 8 inches in diameter and about 350 feet deep; and the water standpipe is carried straight up about 40 feet to the roof of the structure, where a small tank is placed. The demand for water is so constant that no storage is required, and the tank really serves only to separate the air from the water. The water flows from the tank through the plant by gravity.

This establishment is a striking example of how economy in air consumption can be effected by the application of proper engineering principles. When first put in operation the ice plant required a compressor with a piston displacement of almost 500 cubic feet. Subsequently, the equipment was carefully gone over, with the result that the changes made brought about a saving of almost 50 per cent. in the consumption of air. The economies were effected in two ways: First, all the air lines were checked up and, wherever possible, 90-degree elbows were removed, and, where a change of direction was necessary, long sweep bends were substituted for elbows; and, secondly, it was decided that the piping of the air-lift pumping system—that had been installed with a view to taking care of future requirements—was too large. As it was, a 5-inch water standpipe and a 1½-inch air pipe were in use. A 4-inch water standpipe with special thin pipe couplings was then lowered inside the 5-inch pipe, and the 1½-inch air pipe was discarded in favor of a ¾-inch air pipe. As the demand for water is so continuous and as air at different pressures is needed for various purposes around the plant, a pressure regulating valve was placed in the air line, and this reduced the pressure from 90 pounds to an operating pressure of 45 pounds.

The original installation consisted of a Rand, belt-driven air compressor having a piston displacement of 280 cubic feet. This machine has been in operation almost continuously for twenty years, and is still giving excellent service. In addition, there were two Type EL-1, 8x8-inch compressors with short belt drive. One of these machines was removed when the alterations were made and the second one was left

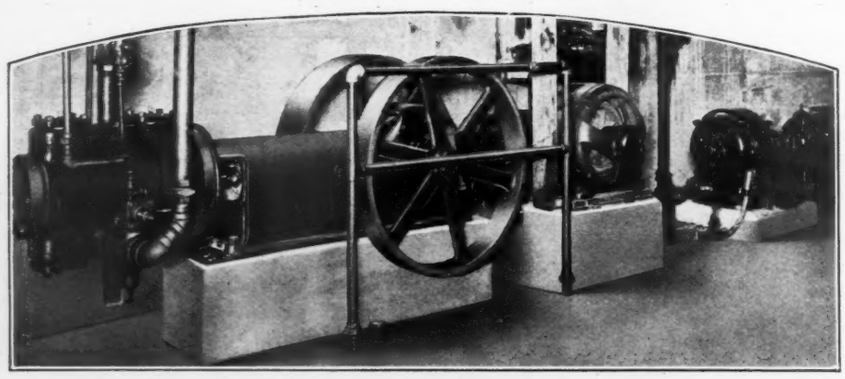


Here we have the main features of the air-lift system as installed in a corner of the basement of the Crescent Creamery Company's ice-cream plant.

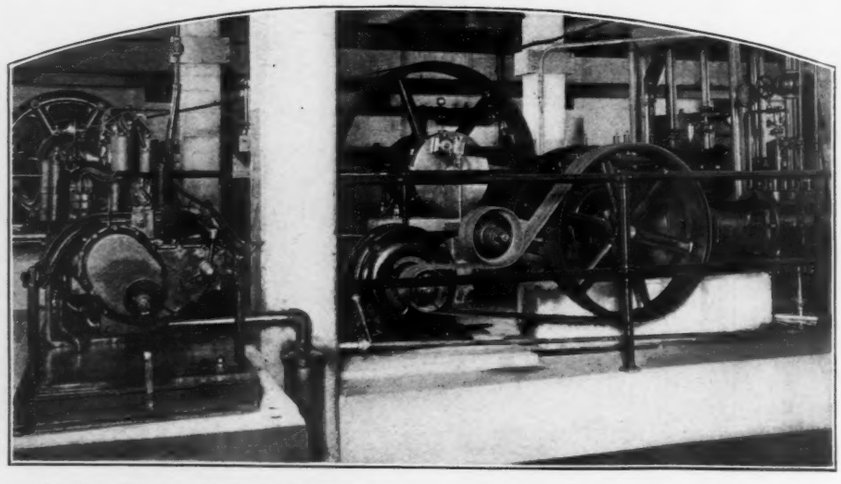


In addition to using compressed air to operate the hoist in the tank room, the Arctic Ice Company, Ltd., employs this medium to pump water from an Artesian well and to agitate the water in the ice cans.

Well head, with 90-degree headpiece, showing the simplicity of the outdoor features of the air lift at the Crescent Creamery Company's plant.



The 8x8-inch C'ass ER-1 compressor, with short-be't drive, which furnishes operative air for pumping water at the plant of the Crescent Creamery Company.



In background, old Rand compressor which has been giving good service for twenty years in the plant of the Arctic Ice Company, Ltd., and is still going strong. In foreground, one of the 8x8-inch EL-1 compressors with emergency automobile engine at left.

for standby purposes only. The present installation is shown in an accompanying picture, and attention is drawn to the automobile engine at the left. This engine was added to the equipment as a precautionary measure in order to guard against a failure of the air supply, inasmuch as a 10-minute interruption would mean the loss of all the ice in process of manufacture. The motor is fitted with a pulley and a long belt, and can be connected to the standby compressor in a very few minutes by simply removing the short belt from the electric motor and substituting the long belt from the gasoline engine.

Besides using compressed air for pumping water from the well and for agitating the water in the ice cans, it is also utilized to operate a hoist to lift the ice dumped from the cans and to carry it to the daily storage rooms; to convey the ice to the permanent storage rooms; and to operate a direct-lift hoist for harvesting the ice, as shown in one of our illustrations. In this picture can be seen the air manifold, running along the wall, from which the air is taken for agitating the water while it is undergoing freezing. The pressure reducer is also shown on the wall directly behind the three ice cans. This establishment is interesting not only because compressed air has been put to service wherever possible to operate mechanical labor-saving devices but because it is the first all-Canadian ice-making plant built in Canada.

The saving effected by the air-lift system in this case can be readily appreciated when the added advantages of pure, cold water in an industry of this kind are taken into consideration. In other words, economies are effected through the use of cold water for condensing purposes; through the lower initial temperature and the purity of the water put in the cans for the manufacture of ice; and, lastly, through the pumping of the water, itself, which costs less than two cents per 1,000 gallons as compared with the city water rate of nineteen cents per 1,000 gallons.

The air-lift system for pumping water has become so firmly established in Winnipeg that any plans of a new plant, requiring a supply of pure, cold water, always include an air lift as part of the regular equipment.

RECORD TRAIN OF NEWSPRINT

A train made up of 42 cars of newsprint—the longest train of newsprint that has ever left northern Ontario, arrived in Toronto on August 24. It came from the Abitibi Pulp and Paper Company's plant at Iroquois Falls, and left North Bay drawn by one of the latest type of passenger locomotives which the Canadian Pacific is building at its Angus shops. Ordinarily it would have required two engines to haul this train of more than 1,100 tons; but a record was established when the huge engine, with its string of cars, arrived in Toronto without mishap. Water was taken on but four times during the trip. Included in the train were cars for the various newspapers in Canada and for twelve United States newspapers; and the entire shipment represented timber cut on more than 200 acres of pulpwood.

Electrical Energy from the Saguenay River

The Quebec Development Company is Erecting a Great Hydro-electric Power Station at Isle Maligne, Grand Discharge, Lake St. John, Quebec

By A. A. BOWMAN, B.Sc.

STRETCHING northwesterly in ever-increasing distance from the ancient city of Quebec is the magnificent hinterland which lies around Lake St. John. It is a land of mountain and plain, of lake and river, of forest and farm. Known hitherto principally by the hunter and the fisherman in quest of moose and bear, of trout and ouininische, and inhabited by the French Canadian, happy in his hard-working, thrifty, and contented life so characteristic of his Norman forefathers and so wonderfully portrayed by Louis Hemon in *Maria Chapdelaine*. Today, the Lake St. John district is taking its rightful place in Canadian industry.

The watershed between the St. Lawrence and Hudson Bay is drained by the Peribonka, the Mitassini, the Ashuapkuchuan, and other smaller rivers, all flowing into Lake St. John from which the majestic Saguenay, far famed for the grandeur of its scenery, flows for 100 miles to enter the St. Lawrence at Tadousac. Important and highly efficient power plants are already in operation at Jonquiere and other points, where they furnish energy for the operation of mills engaged in the manufacture of wood pulp and paper; and additional water powers are now in course of development on the Saguenay.

The Saguenay—known to thousands of tourists—flows out of Lake St. John in two branches, bearing the names of Grand Discharge and Little Discharge, which unite about nine miles from the lake and form Alma Island. The river descends for 28 miles to tidewater at Chicoutimi, from which it is navigable to Tadousac. This rapid fall of water is capable of producing about 1,060,000 H.P.; and half of this energy is being developed on the Grand Discharge at Isle Maligne, a small island in the Grand Discharge about six miles from Lake St. John. The remainder can be concentrated for use, on the Saguenay, a short distance below the entrance of its tributary, the Kenogami; and this will be done as soon as there is a market for the power.

NO longer than fifteen years ago the officials in Ontario who advocated developing and marketing 100,000 H P. from Niagara Falls were commonly classed as impracticable and even dangerous visionaries. At this moment the Province of Ontario is marketing substantially 600,000 H.P. generated by the waters of the Niagara River.

And now we have the story of a momentous step in the further development of the power potentialities of the famous and beautiful Saguenay. The engineering project which is underway on that stream will produce quite 1,000,000 H.P. This undertaking should be a boon both to Canada and to those parts of the United States lying within transmitting distance of this enormous block of electric current.

The plant now building at Isle Maligne will be one of the largest and most efficient hydro-electric power stations on the continent of North America. The whole project is being carried out by The Quebec Development Company, Ltd., whose officers are Mr. J. B. Duke, president; Sir William Price, Mr. W. S. Lee, and Mr. F. H. Cothran, vice-presidents. Mr. W. S. Lee, with offices at New York City and Charlotte, N. C., is chief engineer; and Mr. W. I. Bishop of Montreal is consulting engineer. The Quebec Development Company is doing its own work, and has a first-class construction plant. Mr. Cothran is in

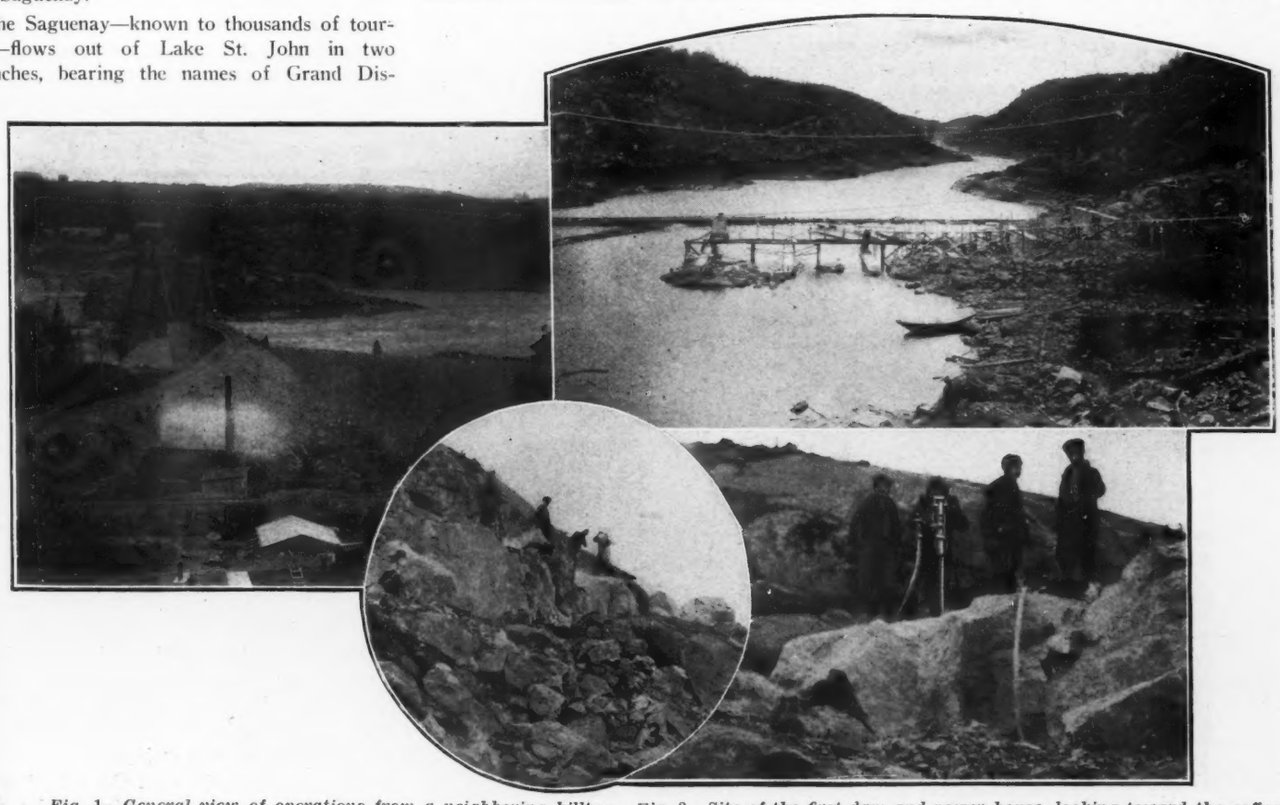
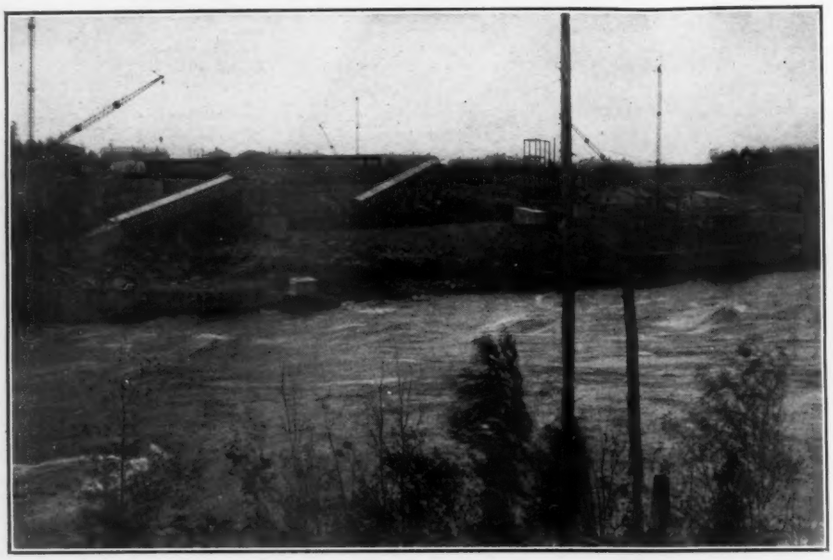


Fig. 1—General view of operations from a neighboring hilltop. Fig. 2—Site of the first dam and power house, looking toward the cofferdam. Fig. 3—"Jackhamers" drilling bench in quarry. Fig. 4—DDR-13 drills are also in service in the quarry where large quantities of rock are being removed.

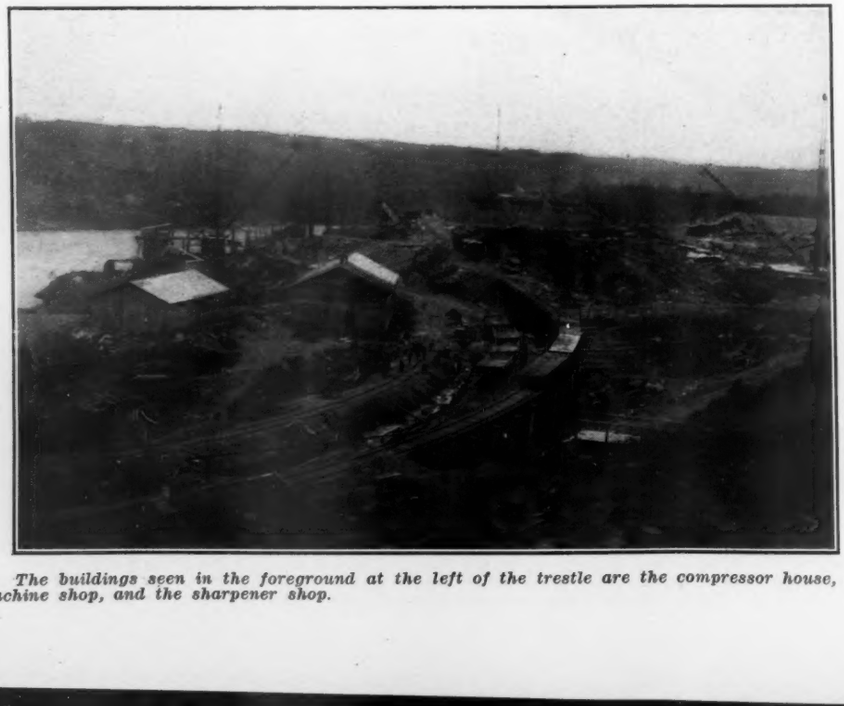


How the rock-crushing and the concrete plants appear from the opposite side of the river.

charge of the work; and Mr. D. F. Noyes is second in charge. Messrs. H. G. Cochrane and J. P. Chapleau are resident engineers, and Mr. S. F. McDougal is master mechanic.

The construction plans call for a dam on the Grand Discharge, and for a second dam with three spillways on the three channels of the Little Discharge, thereby controlling both branches of the lake outlet. The power house, itself, forms the largest of the dams, and will be built across the Grand Discharge from Isle Maligne to the north shore of the stream. Three overflow spillways and a control spillway will be constructed on the north shore of Isle Maligne, above the power house. In this power house will be placed twelve turbo-generator units of the vertical type, each of 40,000-H.P. capacity, giving a total development of 480,000 H.P. The turbines will operate under a head of 120 feet. The generators will produce 3-phase, 60-cycle current. The power house will be 700 feet long and 150 feet high from subfoundation to the top; and, with its wing walls, will require about 235,000 cubic yards of concrete. The construction of the whole work will necessitate the excavating of substantially 250,000 cubic yards of rock and the utilization of more than 500,000 cubic yards of concrete. The rock from the tail-race excavation and quarry will be delivered by cars to the primary jaw crushers, and from the latter it will be carried by conveyers to secondary crushers and to the bins and the mixing plant. These bins will have a capacity of 1,000 cubic yards. A steel trestle 55 feet high, running the length of the power house and supporting three tracks surmounted by traveling cranes, will handle rock and concrete during the construction period, and afterwards will become a permanent part of the station equipment.

Being a pioneer, like the French Canadian, compressed air has been used at Grand Discharge from the very beginning of operations.



The buildings seen in the foreground at the left of the trestle are the compressor house, the machine shop, and the sharpener shop.

The first work consisted of building a cofferdam or rock-filled bulkhead, faced on the upstream side with planking, and situated on the left bank of the Grand Discharge a short distance above the power-house site. Twelve miles of railway from Hebertville on the Canadian National Railway to the power house, together with the necessary yardage sidings, were constructed. For these operations, portable and stationary compressors, and pneumatic tools and rock drills were used. The portable compressor is an 8x8-inch, Type 14, gasoline-engine unit of 210 feet displacement. The stationary compressor is a combined steam-driven and power-driven Class FL-1 machine of 340 feet displacement, supplied from a 100-H.P. boiler. "Little David" wood-boring drills were used on the cofferdam; and "Jackhamers," of the BCR-430 and DDR-13 types were employed in excavating the rock.

The main air compressor plant is now in operation and consists of two synchronous-motor-driven, direct-connected, cross-compound compressors of the Class PRE-2, clearance-control type, each having cylinders of 25 and 15¾ inches in diameter with 18-inch stroke and a capacity of 2,033 cubic feet of free air per minute. The motors are of 350 H.P. each, taking 3-phase, 60-cycle current at 2,300 volts. The rock-drill equipment includes drills mounted on tripods besides the "Jackhamers" already mentioned. The drill steels are sharpened by two "Leyner" sharpeners No. 550 after the drills are heated in "Leyner" oil furnaces. Some of the accompanying photographs show the different machines in service, including a sturdy Cameron direct-acting pump attending strictly to business, at the water's edge, although occasionally drenched by a passing wave. This whole compressed air installation, with its accessories, was manufactured by the Canadian Ingersoll-Rand Company, Ltd., at its works in Sherbrooke, Que.

The Quebec Development Company has made rapid progress since beginning the present undertaking at the start of the current year. The cofferdam, already referred to, was completed early in April; and the construction railway has been in operation for some time. Both of these features of the job were carried forward despite adverse weather conditions. The railway bridge across the Grand Discharge was in course of erection when visited by the writer, and was scheduled to be finished during October just ended. Power is being supplied from Kenogami to operate the construction machinery. It is expected that power from the first Isle Maligne unit ready will be used to complete the work. The spillway dams will be built when the power house is finished. Tracks will be laid this coming winter on Isle Maligne for the building of these spillways next year. This winter's operations will include the general carrying along of the construction work, and will embrace among other things, the erection of the upstream half of the power house. A cofferdam is also to be built so as to permit pumping out the tail-race site next spring.

The Quebec Development Company has put up offices, camp structures, homes for their married employees, and a comfortable com-

munity house. These are placed on the high bank of the river overlooking the whole scene of engineering activity, and are equipped with modern conveniences. Everything possible is being done for the welfare of the personnel.

The question naturally arises, To what use will this great volume of electric power be put? Undoubtedly, this splendid plant will attract industries to the neighborhood, especially those that require large blocks of energy as well as the raw materials available in the district. While hydro-electric power is of outstanding value wherever it can be obtained and transmitted for reasonable distances, there is a natural tendency for it to be used near the point of production. In this particular case it should be recalled that mechanically produced wood pulp demands from 70 to 80 H.P. per ton. Of this amount, approximately 67 H.P. is for grinding. Sulphite pulp consumes from 8 to 30 H.P. per ton, depending upon the process. From this it will be seen that there are immense power-consumption possibilities in the development of the extensive pulpwood areas in the surrounding district, which is already one of the most important pulp-producing areas in Canada. Other industries using pulp-wood products as their raw materials will also find the Lake St. John region a natural site for their mills.

Many other industries will probably utilize the Isle Maligne power. In all likelihood, the heavy-mineralized belt, reaching from Lake Superior across northern Ontario and including the famous Sudbury, Cobalt, and Porcupine mining camps, will be found to extend across northern Quebec. Evidence to this end is shown in the value and the importance of the new mining field at Rouyn; and further prospecting may lead to mining discoveries to the eastward. It is not too much to hope that northern Quebec will develop into a mining district comparable with northern Ontario; and the hydro-electric power station at Isle Maligne may do much towards making this an accomplished fact. While, as we have stated, the aim of The Quebec Development Company is to assist in attracting industries and to create a market for its power in the district, current can, of course, be transmitted long distances. California is now dispatching electric energy efficiently over lines 360 miles long, and the same thing can be done in Canada.

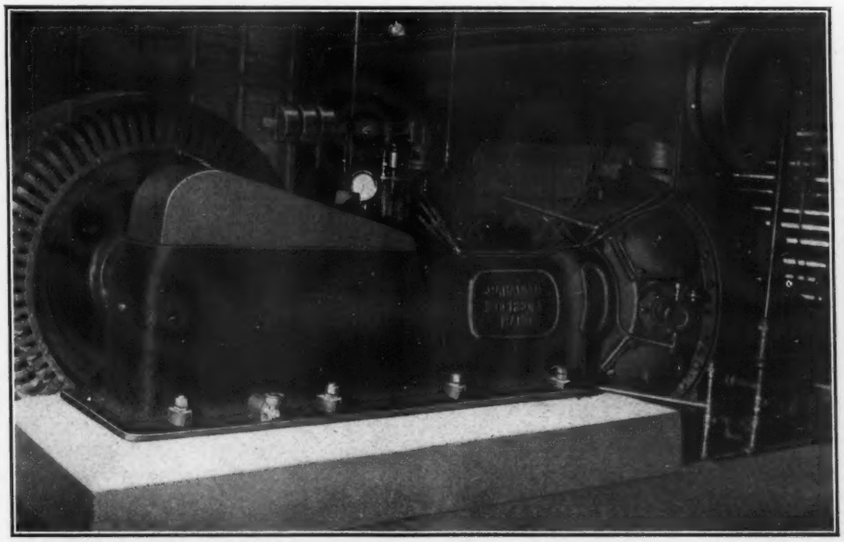
Right on the job in an awkward place. A Type 14 portable compressor.

Although frequently submerged by a passing wave, this Cameron pump continues to do its full and helpful duty.

Canada gave mightily to "save the world for democracy," but in so doing she incurred a tremendous war debt for a young and growing country to carry. To the writer, it seems that she should be able to enjoy a splendid revenue through the exporting of her natural power which, renewable second by second, cannot be open to any objection because of a menace to her native resources. Not only that, but it is a commendable aim to utilize to the full her inexhaustible gift of energy—which otherwise would go to waste—for the benefit of those parts of her own domain and neighboring sections of the United States where more electricity is needed and can thus be made available.

Perhaps the problem which confronted *Maria Chapdelaine* in choosing between a pioneer and a village life may not now be so difficult to solve; and, by the modern utilization of its resources, this wonderful land may in the future become a home for thousands of people and a boon for them and for the country of which it forms a part.

The writer wishes to acknowledge his indebtedness to the Engineering Institute of Canada and to Mr. H. G. Cochrane for data supplied him for the preparation of this article.



A PRE-2 compressor having a capacity of 2,033 cubic feet of free air per minute. One of the two units of the present main compressor plant.

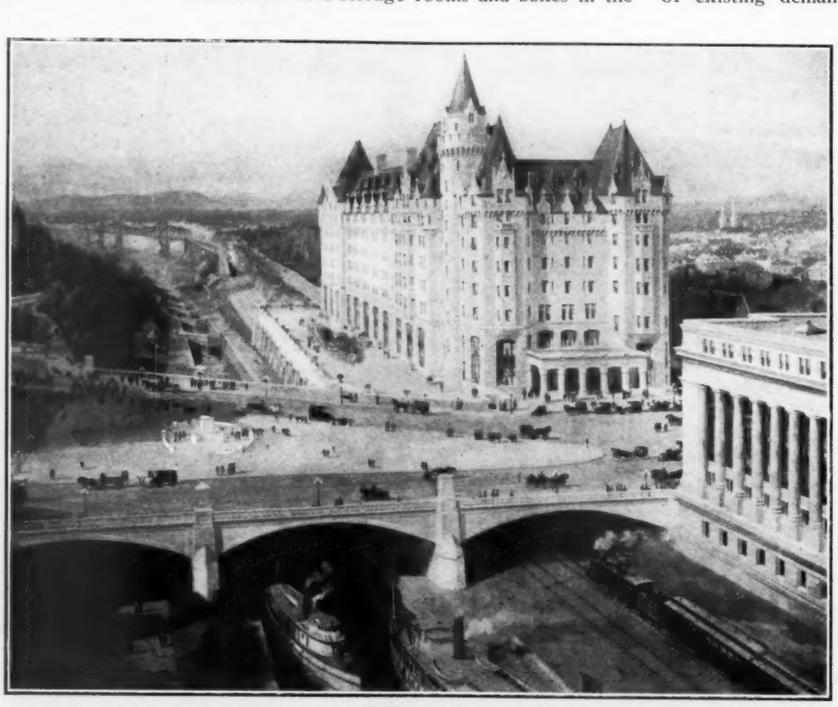
New Refrigeration Equipment at the Chateau Laurier Hotel, Ottawa, Ontario

By F. A. MACK

THE RAPID development of hydro-electric power plants in Canada and the low rates charged for power in many sections of the country have led a number of owners of ice and refrigerating plants to discard their old-style steam-driven equipment in favor of constant-speed, direct-connected, electrically driven machines. Some power companies quote a special low rate for refrigeration or ice-plant service as it tends to flatten out their load curve by keeping up the demand for current during the summer months when electricity for lighting and heating is least used.

The application of motor drive to ammonia compressor service was, however, until quite recently, badly handicapped by the lack of machines capable of operating at other than very low speeds and by the fact that proper regulation of the output to suit the demand could only be obtained by the use of costly, special variable-speed motors.

The introduction of machines of more modern design—embodying such improvements as enclosed-frame construction, automatic lubrication, large port areas, high-speed plate inlet valves, and hand-operated clearance control which permit regulating the output to suit the variable demand for refrigeration throughout the year—has made possible the use of moderate-priced, constant-speed synchronous motors. This has placed motor-driven ammonia compressors within the reach of many who otherwise could not take advantage of the numerous economies offered by this type. In some cases, motor-driven equipments have been installed to handle the regular load, and the older steam-driven plants have been retained for standby purposes.



The Chateau Laurier, Ottawa's justly famous hotel. Station of the Canadian National Railways at the right with Rideau Canal in the middle foreground.

In the Canadian National Railways' hotel, the *Chateau Laurier,* at Ottawa, Ont., there was recently placed a direct-connected, motor-driven ammonia compressor t take over the load formerly handled by two old-style, open-frame, steam-driven units which were retained for breakdown service. The new machine is a Canadian-built 11 and 7¾x12-inch Ingersoll-Rand PRE-2 A direct-connected, horizontal, duplex, double-acting, 2-stage ammonia compressor, without intercooler. This unit has hand-operated clearance control pockets for unloading the compressor to three-quarter or one-half capacity. It is driven by a Canadian Westinghouse 155-H.P., 257-R.P.M., unity power factor, 122°F., 2-phase, 60-cycle, 2,200-volt, engine-type, direct-connected, synchronous motor with belted exciter.

The load on this compressor comes principally from a brine cooler, which serves the hotel, and the remainder from an ice-making tank and an ice-storage room. There are also numerous cold-storage rooms and boxes in the culinary department of the *Chateau Laurier,* which is renowned for the excellence of its cusine. These are used to cool, during storage, the large quantities of meat, vegetables, and provisions that are eventually served the guests. Most of the rooms and boxes are kept at a temperature of between 32 and 40°F., while one or two rooms are cooled below 32°. The ice is used in water coolers on passenger cars and for table service at the hotel. In the *Chateau Laurier,* cooling is accomplished by means of brine circulation. The brine is refrigerated in a double-pipe brine cooler located near the compressor, ice tank, etc. within the power plant adjoining the hotel. The brine cooler is enclosed in an insulated compartment.

The reasons for adopting this particular type of compressor may be summarized as follows: Electric power was found so cheap, compared with steam, that conversion to electric drive was warranted even on the basis of installing new equipment. A little more capacity was needed for extreme peak loads on hot days in summer, and added capacity was required to take care of a contemplated increase in the output of ice.

Synchronous motor drive was desired, and a direct-connected unit was practicaily necessary on account of the small floor space available. It was also necessary to install a compressor which would have capacity in excess of existing demands and yet permit efficient operation at underload points. This condition is met by the hand-operated clearance control pockets which enable running at three-quarter or at half the rated capacity. These pockets make it practicable for the compressor to take care of reduced winter loads or to operate the compressor with either high or low suction pressures. This system of regulation also permits starting and stopping the compressor in gradual steps. This results in less severe motor duty, and likewise eliminates fluctuations in the power lines due to throwing the load "all on or all off."

As previously mentioned, the new machine takes over the load from two old-style steam-driven machines which are now used for stand-by purposes. These old machines were rated at 20 tons each and were operating on about 30 pounds back pressure. At the usual figure of 15 to 185 pounds, this would mean that each machine was delivering about 30 tons when working at this back pressure, or a total load of 60 tons. The new equipment pulls the back pressure down to 10 pounds and maintains approximately the same load pressure as the other machines, but, besides handling the brine-cooling load formerly carried by the old units, the new compressor also takes up the freezing-tank load and the ice-storage-room load, which were formerly thrown off for a while each day when the two old units were required to handle the brine-cooler load alone.

A total of 33,000 men, drawing $40,000,000 a year in wages, are on the pay rolls of the pulp and paper mills in Canada.

Compressed Air Haulage in the Coal Mines of Western Canada

By S. A. WILLIAMS

THE HISTORY of the compressed air locomotive for mine haulage dates back to 1873, and the use of this form of tractor was inspired mainly by a desire to obtain increased safety, reliability, and simplicity in this field of work. Indeed, the elements of safety and reliability have determined, in most cases, preference for compressed air haulage over electric traction. Only a few compressed air locomotives were built between 1873 and 1895, but in the thirteen years following several hundred single-expansion locomotives of this type were constructed principally for underground haulage in coal mines. From 1908 until the present time, a large number of 2-stage or compound compressed air locomotives have been built. The compound air locomotive is from 30 to 50 per cent. more efficient than the single-expansion engine, and for that reason the majority of the installations since 1908 have been of the 2-stage or compound type.

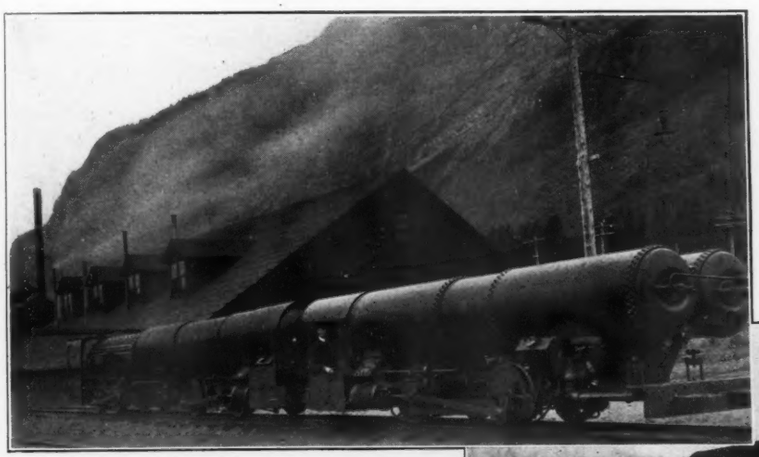
The first air-haulage plant in western Canada was installed nineteen years ago at Coleman, Alberta, by the International Coal & Coke Company, Ltd. This plant consisted of a B2T compressor and three air locomotives built by the Canadian Rand Drill Company, Ltd., of Sherbrooke, Que., now the Canadian Ingersoll-Rand Company, Ltd. This compressor had duplex steam cylinders of 16-inch bore and 24-inch stroke and the air was compressed from atmospheric pressure to a final discharge pressure of from 1,000 to 1,200 pounds. The low-pressure air cylinder was 18 inches in diameter and had a stroke of 24 inches; and the air in this cylinder was compressed to from 25 to 30 pounds. The air was then passed through an overhead intercooler to the second-stage cylinder, of 10½-inch bore and 24-inch stroke, and compressed to about 100 pounds. Next, the air was carried through another intercooler to the third stage, at which it was compressed to about 375 pounds by a plunger of 9-inch diameter and 24-inch stroke, and finally passed through another intercooler on its way to the fourth and last stage. In this stage, a plunger of 5-inch diameter and 24-inch stroke compressed the air to the final discharge pressure of from 1,000 to 1,200 pounds. The first and the second-stage cylinders were double acting, that is, the air was compressed on both sides of the piston; and the third and the fourth stages were single-acting plungers—the air being compressed on one side of the plunger only. The third and the fourth-stage plungers were packed with metallic packing rings.

The air line consisted of a quantity of extra-heavy piping tested to a pressure of 1,800 pounds per square inch; and the charging stations were placed at the mouth of the mine and at partings. These charging stations were provided with flexible couplings so that the locomotives could be charged in a fraction of a minute. Of the locomotives put in service at Coleman in 1904, one had duplex cylinders of 6-inch bore and 10-inch stroke and the two others had duplex cylinders of 5-inch bore and 10-inch stroke. The air tanks carried by these locomotives were charged to a pressure of 800 pounds, and the air was passed through a reducing valve at a pressure of about 160 pounds. It then entered the cylinders, and, after performing its work there, was exhausted into the atmosphere. The grade of the track in this mine is about one-half of one per cent. in favor of the loaded cars. The larger locomotive was used for the main haulage and the smaller ones for gathering the loads and for distributing the empties.

It is now nineteen years ago since this plant was obtained, and the compressor and two of the locomotives are still in continuous service. One of the locomotives was damaged in a fire several years ago, and on account of the greater efficiency of the 2-stage locomotive it was not deemed advisable to repair the injured unit. The power house was burned last fall, but the compressor was repaired and was again in running order in about a month. Since 1904, the International Coal & Coke Company has installed two more high-pressure compressors of the same capacity and has also put in service several 2-stage locomotives of the Porter type.

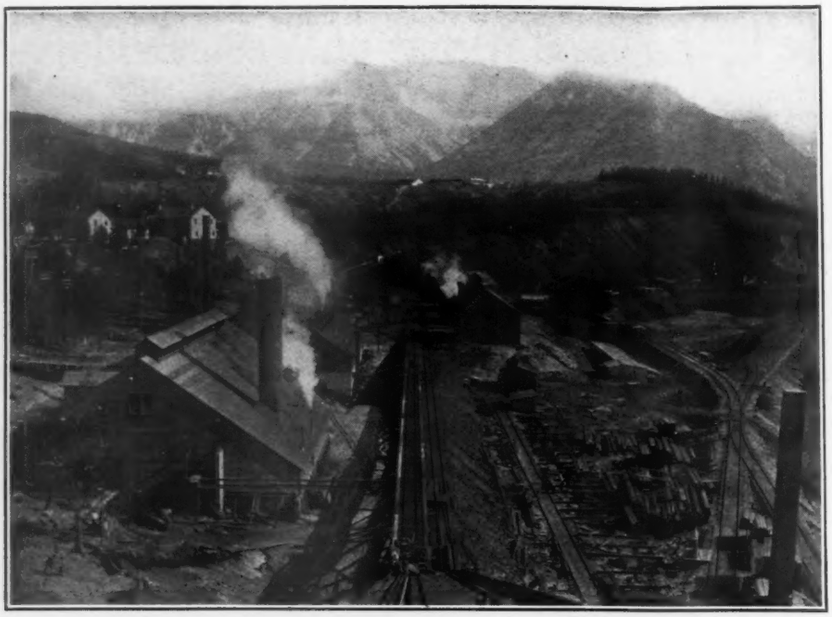
In 1905, the Bankhead Mines at Bankhead, Alberta, installed a cross-compound, Corliss, steam-condensing air compressor, having a capacity of 1,346 cubic feet per minute, and compressed air locomotives of the double-tank type, all of which were built in Canada. In the same year the Crows' Nest Pass Coal Company equipped their No. 8 mine at Michel, B. C., for air haulage. This plant consisted of a Rand, Class B2T compressor and Porter air locomotives. In 1908, this compressor was sold and a cross-compound, Corliss condensing compressor, with a capacity of 1,346 cubic feet of air per minute, was substituted. Within the year, the Crows' Nest Pass Coal Company put a duplicate of the compressor at Michel in their Coal Creek mines, together with several Porter locomotives.

About that time the West Canadian Collieries adopted air haulage in their mines at Lille, Alberta. They installed a high-pressure compressor and Porter locomotives. The H. W. McNeill Coal Company at Canmore, Alberta, and the Hosmer mines, Hosmer, B. C., next followed the lead, and then the Corbin Coal and Coke Company at Corbin, B. C., installed a cross-compound compressor and

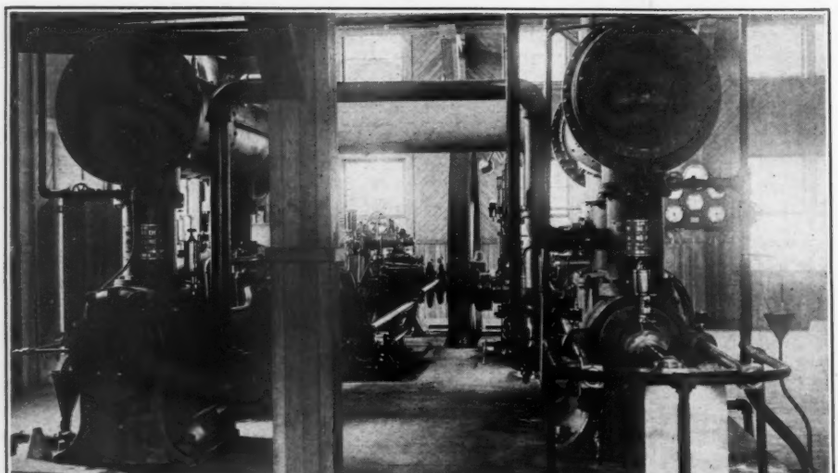


Double-tank type of compressed air locomotives, built in Canada, have been used for years at collieries in Alberta.

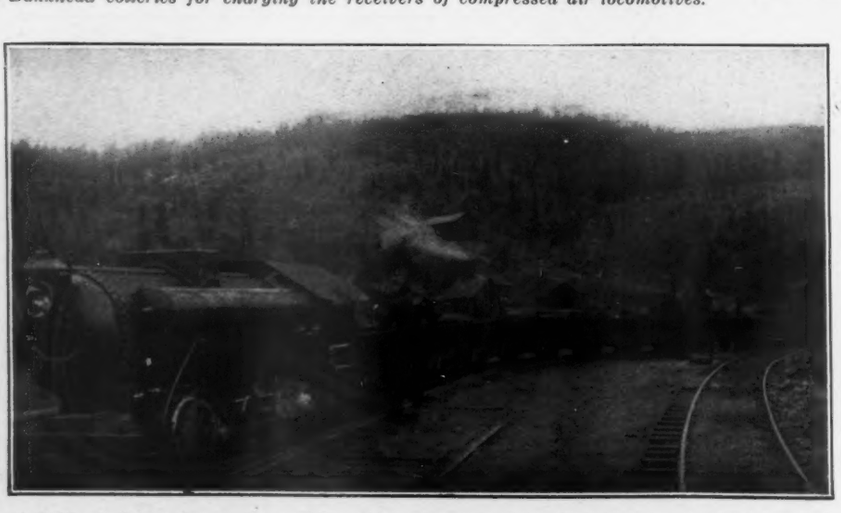
Close-up of the cab of a compressed air locomotive. The engineer's seat is low and it is easy for him to step out and onto the ground or vice versa.



In the heart of Canada's coal fields. The surface workings at a great colliery in Alberta where much of the coal burned in western Canada is mined.



High-pressure compressor, with a capacity of 1,346 cubic feet of free air a minute; installed at the Bankhead colleries for charging the receivers of compressed air locomotives.



A 6x10 air-driven locomotive and its string of cars. One of the units in the service of the International Coal & Coke Company at Coleman, Alberta.

2-stage air locomotives. These, it is said, were the first 2-stage or compound locomotives in western Canada.

The 2-stage locomotive was designed to expand the air in two successive cylinders with an atmospheric interheater placed between them—the exhaust air from the high-pressure cylinder passing through this interheater on its way to the low-pressure cylinder. The interheater is constructed on lines similar to those of an intercooler on an air compressor, but instead of water a current of air from the surrounding atmosphere is drawn through the tubes. The temperature of the exhaust air from the high-pressure cylinder is about 140°F. below that of the atmosphere. This air surrounds the tubes in the interheater, and, in consequence, enters the low-pressure cylinder at nearly the same temperature as that of the atmosphere. The air entering the high-pressure cylinder has a pressure of about 250 pounds, while the air going into the low-pressure cylinder has a pressure of about 50 pounds.

In 1913, the Jasper Park Collieries, Pocahontas, Alberta, installed a compressor and put in service three 6x12x12-inch Porter locomotives; and eight years later the McGillivray Creek Coal & Coke Company at Coleman, Alberta, decided to equip their properties for air haulage. It might be mentioned in passing, that Foley Brothers, Welsh & Stewart employed a compressed air haulage plant at each end of the Connaught Tunnel, at Rogers Pass, on the main line of the Canadian Pacific Railway. This is a double-track tunnel, five miles long. The locomotives were used to haul standard railway dump cars that were filled with rock by air-driven shovels working in the tunnel. Small air locomotives were also used to haul the muck out of the pioneer tunnels.

Compressed air haulage was chosen for this work only after a thorough investigation of the different types of haulage; and it is evident that this system came up to expectations, inasmuch as the tunnel was completed 364 days ahead of the specified time—the contractors earning a substantial bonus in consequence.

Compressed air haulage is simple, reliable, and efficient, and a man with ordinary intelligence can, in a very short time, become an expert "dinkey" runner. The smaller sized locomotives of this character will operate over curves having as much as a 12-foot radius. In gaseous coal mines, lumber yards, explosives factories, textile plants, etc., the compressed air locomotive assures a measure of safety that cannot be claimed for engines of other kinds, as evidenced by actual experience.

Several years ago, a mine in the Alberta district caught fire. The compressor was promptly stopped; a large pump was connected to the air line; and by thus converting the system into a water line the fire was put out. In cases of emergency, such as a breakdown of the regular low-pressure compressor plant, the high-pressure air can be reduced to 100 pounds and used to operate "Jackhamers" and direct-acting pumps. Out of a total of twelve air haulage installations in western Canada, the Canadian Ingersoll-Rand Company supplied the compressors for eleven—or a total of fifteen machines.

Oil-Engine Drive Promotes Ice-Plant Efficiency

The Establishment of the Central Ice and Cold Storage Corporation at Vineland, N. J., a Fine Example of Up-to-date Engineering

By ROBERT G. SKERRETT

THE INCORPORATED city of Vineland and the contiguous township of Landisville have a population of 21,000; and these associated communities are bustling and enterprising. For all practical purposes, the township and the city may be considered as one because of their allied interests, which have in the main to do with agricultural activities. As a matter of fact, Vineland is the business center of a farming zone having a radius of approximately ten miles, within which much attention is given to the growing of fruit, truck gardening, and the raising of poultry.

Vineland lies in that part of southern New Jersey which is subjected to the stabilizing influence of large bodies of water on three sides of the territory. Because of the proximity of the Delaware River, Delaware Bay, and the Atlantic Ocean, the open or growing season is a notably long one—frost leaving the ground very early in the springtime and harmful cold arriving usually rather late in the fall. In addition to this climatic advantage, the soil is fertile and abundantly responsive to cultivation. In short, Cumberland County, in which Vineland is located, is widely known because of its fruitfulness and the amounts of foodstuffs that it ships to the markets of Philadelphia and Greater New York.

Until recently, the people of the Vineland district have obtained from outside sources much of the ice required by them. Recognizing the need of adequate local facilities, the Central Ice & Cold Storage Corporation was organized and the erection of a thoroughly modern plant was begun during 1922. The establishment started its active career on April 15 of the current year, and from June 1 to October 1 it was run continuously at capacity—that is, it turned out at least 50 tons of ice every 24 hours. It is interesting here to record the fact that at one time as much as 59½ tons were produced in the course of a full working day.

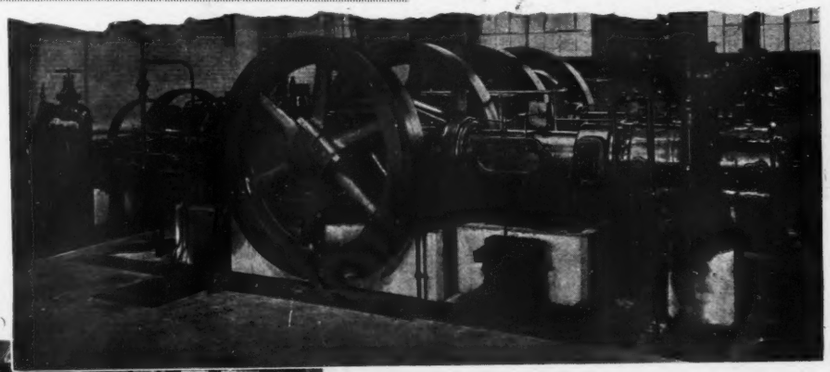
MANUFACTURED ice has become increasingly essential to creature comfort and to industry in many departments of communal life.

Ice of man's making, when produced by the best of modern facilities, is not only superior to that of Nature's forming in some important particulars but its production can be so controlled as to yield a thoroughly hygienic commodity—a matter of prime importance to the physical well-being of the consumers.

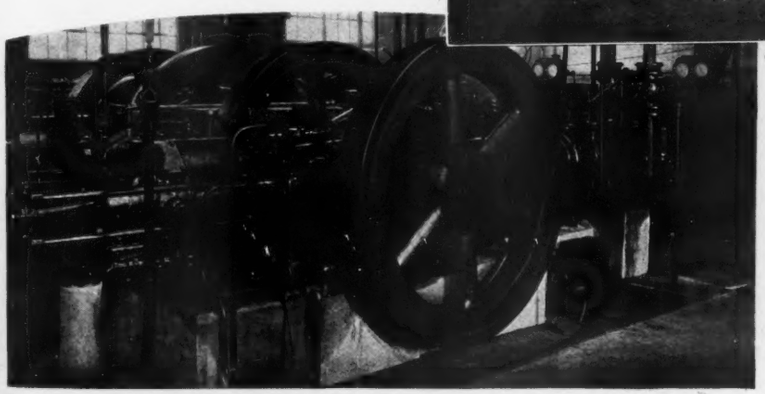
The accompanying article should be of special interest to those progressive citizens of many places who may now have under advisement the establishment of ice-making plants or the remodeling or expansion of existing equipments. Operative economy, efficiency, and the idea of a thoroughly self-contained installation were carefully studied in planning and in outfitting the Vineland plant.

The corporation has had a very satisfactory summer season, and has readily found a market for its product not only in the immediate neighborhood but in Cape May and Wildwood, nearly 40 miles away, to which points 135 carloads—each of 25 tons—were dispatched during the warm months. Locally, the ice was consumed by householders, meat shops, confectioners, soda fountains, etc.—being distributed by retailing icemen. The corporation's commodity has made a hit, especially with the thrifty housewife who has discovered that this particular ice is of a superior character—50 pounds of it, so it is said, serving her fully as well as 100 pounds of the ice previously bought by her. Again, the middleman has been equally pleased, because he has found that the solid, clear cakes would keep well and also cut up into marketable blocks with a minimum of waste or loss.

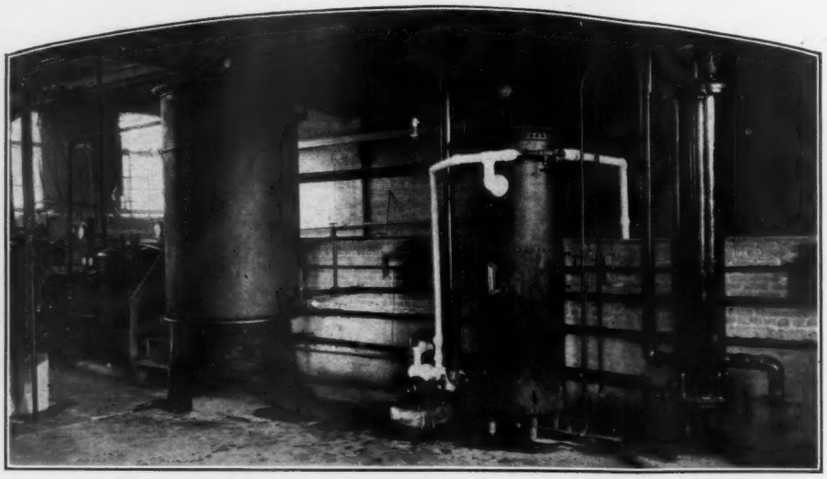
Before describing the equipment of the plant, let us state that the corporation is now adding a cold-storage section to its establishment. This will constitute the first floor of an annex and have a capacity of 100,000 cubic feet. The foundation of the building is strong enough to support a 10-story superstructure; and the aim of the management is to add other floors from time to time as the business develops. The cold-storage space will be ready for service during the current month; and this space will, in all probability, be quickly filled. As a matter of fact, the Vineland district has suffered heretofore by reason of its lack of cold-storage facilities—more than once the farmers have seen their perishable commodities deteriorate while awaiting shipment or while being held back for a profitable market. Some hint of what this part of Cumberland County does towards supplying foodstuffs can be gathered from the fact that the railroads carried away from Vineland last year a total of 3,000,000 dozen eggs—not to mention many hundreds of



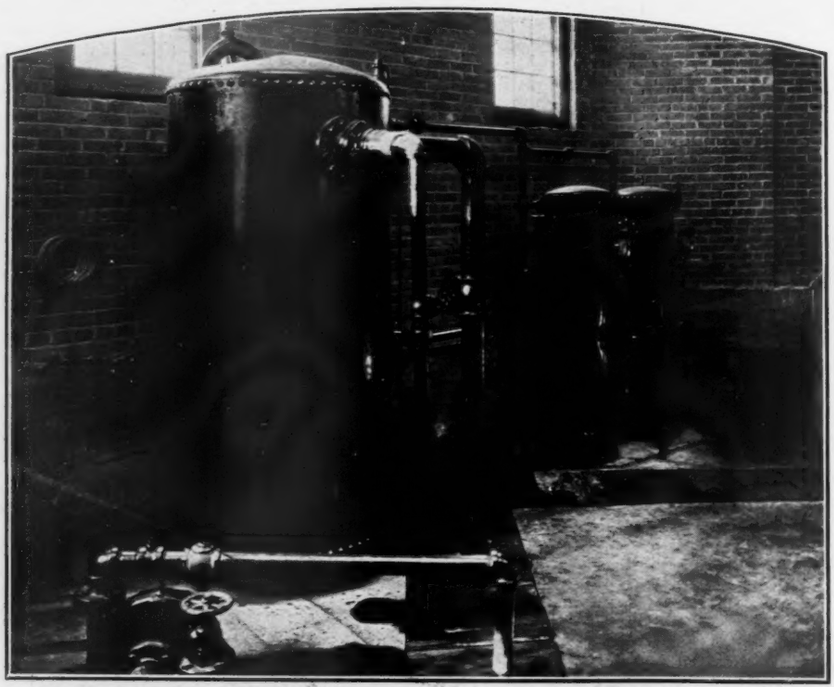
Operating side of one of the two POC-1-A units—the ammonia end of the machine being at the right.



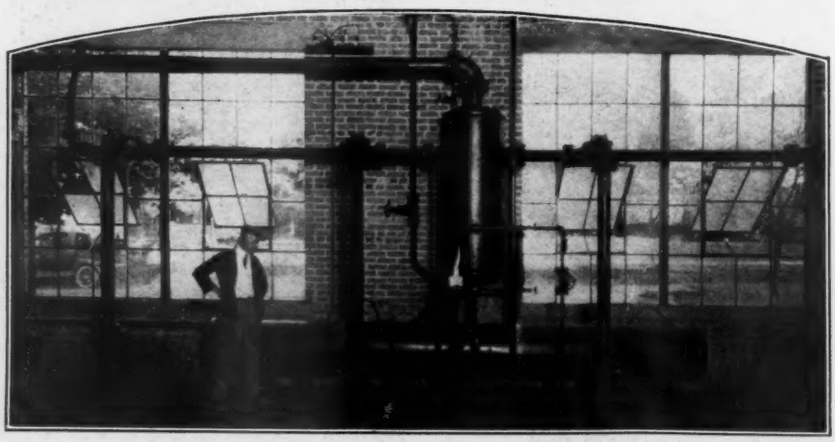
Close-up of the oil-engine end of one of the POC-1-A units.



At right are the two elements of the dehydrator by which moisture is removed from the agitating air. At the left are the water filter and the large forecooler by which the water is lowered nearly to the freezing point before it is delivered to the cans.



Receivers in which air is stored for starting the engines and for operating the air lifts and the water-agitating system of the ice tank.



Business end of the ice tank. The large horizontal tank is the ammonia receiver and above it is the accumulator. At left and right can be seen the motors which drive the two brine agitators.

packages of poultry and thousands of tons of other edible products.

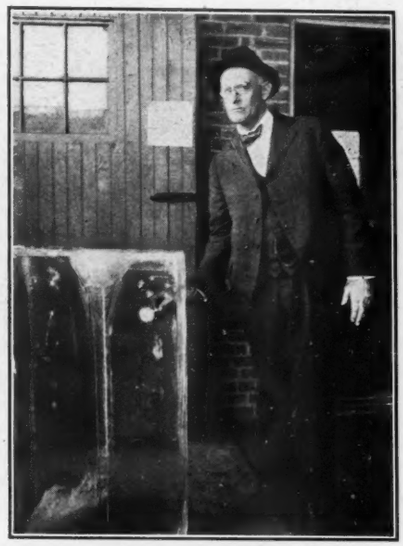
At the outset, it was recognized by the responsible officials of the Central Ice & Cold Storage Corporation that substantial economies could be effected if the projected plant were made entirely self-contained or self-sufficient as far as primary power and water supply were concerned. The city's mains and the municipal electric system could be tapped; but it was decided to do this only as an emergency measure. Experience during the past summer has shown the wisdom of the course adopted. The water used in the plant is pumped by air lifts from two Artesian wells sunk on the property to a depth of 100 feet. Ever since starting up in April, the water has been delivered continuously at the rate of 250 gallons a minute. It is clear and free from sand; and when the sump, into which the air lifts discharge, was examined after months of service no sediment was found. This fact is purposely emphasized so as to bring out later another admirable feature of the ice-making system employed in this typically modern raw-water plant.

Electric current for illuminating, for handling the ice in the tank room and on the loading platform, for driving the brine agitators, for operating a number of centrifugal pumps, and for actuating the compressor which furnishes air for various purposes is generated by a 65-kilowatt dynamo directly connected to a 100-H.P. Ingersoll-Rand oil engine, Type PO, running at 257 R.P.M. Air for starting all the oil engines is provided by a small, belt-driven vertical compressor, Type 15. This machine is required each day for but a few minutes; and this service is the only one for which outside current is needed normally. A pressure of 200 pounds is maintained in the two starting tanks or air receivers which are installed for this purpose.

The main features of the refrigerating equipment are two Type POC-1-A horizontal, direct-connected units, each of 100 H.P., with a refrigerating capacity of 51 tons and capable of producing 30 tons of ice every 24 hours. The oil engine, which forms the power end of each ammonia compressor, is like the PO engine which drives the 65-kilowatt generator except that provision is made for direct connection to the ammonia cylinder. To be specific, the engine is of the single-cylinder, single-acting, direct-injection type, operating on a 4-stroke cycle. Injection is effected by two opposed spray nozzles to which the fuel oil is delivered under pressure by an injection pump. This obviates the employment of compressed air for fuel injection and thus avoids a number of troublesome adjuncts. Heat of compression is sufficient to insure ignition.

The ammonia compressor cylinder is likewise horizontal and directly opposed to the oil-engine cylinder. The cap of the engine crank-pin bearing receives the compressor crank pin, thus transmitting power through the compressor connecting rod and crosshead to the ammonia-cylinder piston rod and piston. This arrangement assures mechanical efficiency of a high order. The double-acting, single-stage ammonia cylinder has all those distinctive features that have won approval for this well-

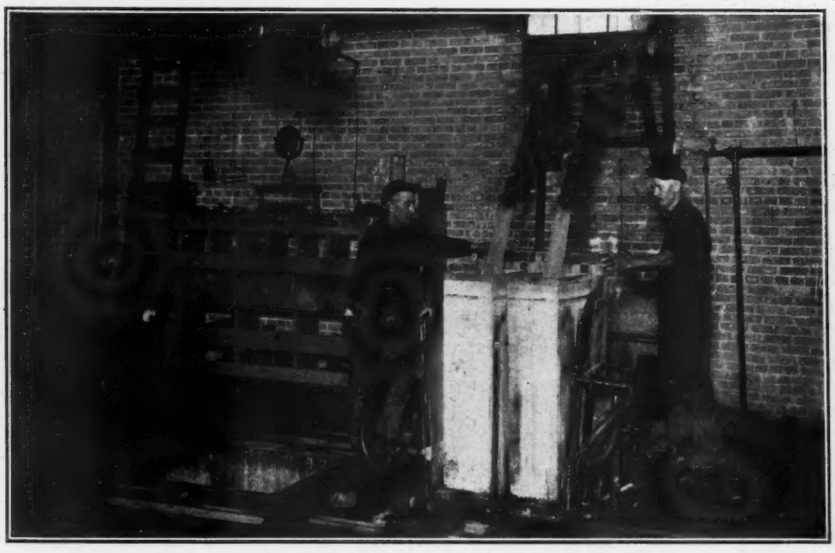
In the storage room, which is capable of holding 60 tons of ice.



Mr. R. C. Wilson, manager of the plant, proves that it is possible to read the time of day through one of his cakes of ice.

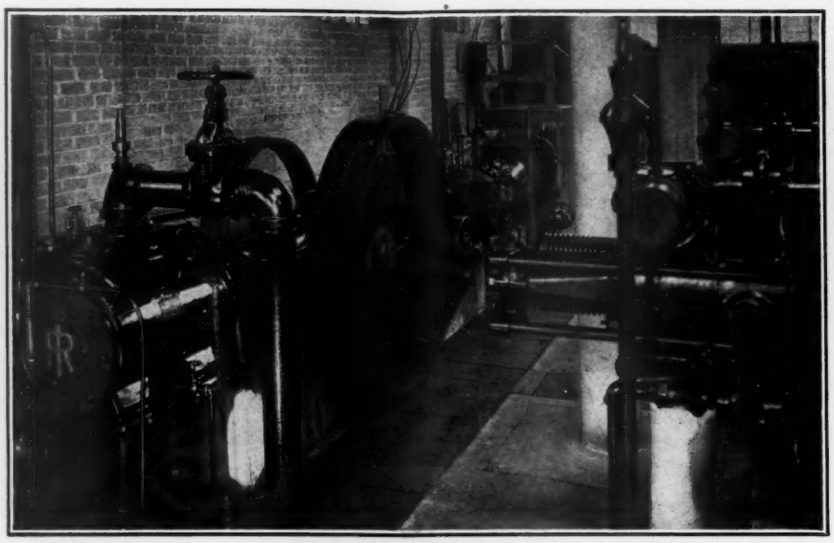
Close-up of the compressed air agitating system in action. The violent movement of the water serves to concentrate impurities in the cores of the cakes from which the undesirable matter can be removed by pumping.

Pumping out cores of forming ice cakes to remove discolored water.



Filling cans with filtered and precooled Artesian well water.

known type of ammonia compressor — among them being plate valves and clearance pockets. The function of the clearance pocket, which is cast integral with the cylinder, is to reduce the capacity of the compressor cylinder whenever this is desirable. Despite the fact that the units are designed to operate under specific pressure conditions, experience has revealed that there are times when an ordinary plant is called upon to run at working pressures which may overload the oil engine unless some form of relief is provided. Clearance pockets meet this requirement and make it possible to compensate for changing service demands. In other words, these ingenious adjuncts permit the compressor to be run not only under ordinary pressure conditions at partial capacity but they make it practicable for the engine to pick up its load gradually when starting. This flexibility is especially valuable whenever ammonia compressors have to take care of the differing needs of a combined ice-making and cold-storage plant. The speed of the unit and, consequently, its capacity can be changed by hand adjustment of the oil engine governor.



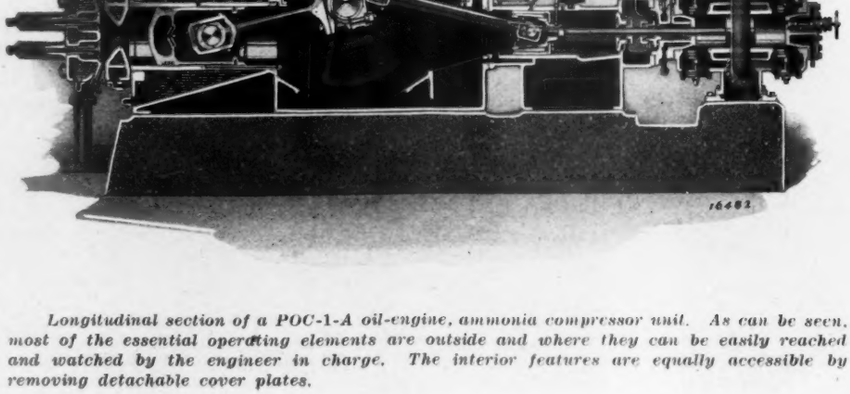
Air compressor which normally provides all the operating air for the air lifts and for the agitation of the water in the ice cans.

Regarding the performances of the three oil engines in the Vineland plant, the chief engineer, Mr. E. W. Davies, frankly says: "I am a steam-engine man and just naturally expected more trouble with an oil-engine installation than with a steam plant of equal capacity. Much to my surprise, the reverse has been the case: the engines just run themselves as long as you feed them oil. If I had a plant to equip I would certainly choose oil engines and particularly engines of the type in question. I have never seen a machine of like power with so few parts, and substantially all these in plain view. I have never had any difficulty in starting these units; and I have found that they will pick up their full load inside of three revolutions. Our fuel cost, when operating to capacity at the height of the season, has not exceeded $24 a day—this covers consumption of the electrical generator unit as well as that of the two POC-1-A units."

The main compressed air equipment is composed of two Class ER-1 compressors, belt driven by separate electric motors. Of these, the machine that regularly furnishes air for the water-agitating system and for the two air lifts is a 14x10-inch unit, while the 12x8 inch compressor, which is driven by current from the city line, is an emergency outfit. The lifts are operated by air at a pressure of 40 pounds, and air at a pressure of 25 pounds is employed for agitating the water in the ice cans. Before the air is fed to the latter system it is passed through two elements which constitute the dehydrator plant. In the first element the air, which enters it at a temperature of 150°F., is cooled by water from the wells. This brings about the precipitation of much of the moisture carried by the air. The final drying is effected by passing the air through the second element, which is brine cooled, and this lowers the temperature of the air to 35°F. and renders it dry enough to be distributed through the piping of the agitating system without fear of clogging the lines with frost or ice. We shall point out presently why the agitating air is maintained at a pressure of 25 pounds.

The water as it comes from the wells has a temperature of 54°F., and this is lowered to 34°F. by running it through a forecooler which is chilled by a direct-expansion ammonia coil. Before the water enters the forecooler it passes through a filter which removes most if not all of the solid vegetable matter that may be held in suspension in the water. Nothwithstanding this pretreatment, the apparently clear water still retains a measure of solid matter, and this is effectually eliminated by pumping out the cores of the forming ice cakes at the proper time. If the water were agitated by low-pressure air instead of high-pressure air, that is, at 25 pounds, well-nigh all the solid matter carried by the water would be frozen in the ice, and the commodity would, to that extent, be inferior and, perhaps, unhealthful. High-pressure agitation, however, in conjunction with the freezing process, keeps out of the forming ice any suspended solid matter and concentrates this in the pool of "boiling" water in the core where the undesirable water can be removed by suitable pumps, as shown in one of our illustrations. The core is then filled with clean water, and the outcome of this procedure is strikingly shown in some of our photographs. The ice is uncommonly clear. Indeed, operations are so conducted at the plant of the Central Ice & Cold Storage Corporation that less than 2 per cent. of white ice is obtained when the tank room is being worked to capacity.

The ice tank, which is 30 feet wide and 72 feet long, accommodates 792 cans, each having a capacity of 300 pounds. There is a set of ammonia coils between each two neighboring rows of cans—in other words, there are 22 coils running the length of the tank. The tank is divided longitudinally into two compartments by a central bulkhead, and each of these subdivisions, in turn, is partitioned lengthwise save near the ends. This arrangement makes it possible for the electrically driven Dimco agitator in each of these compartments to maintain



Longitudinal section of a POC-1-A oil-engine, ammonia compressor unit. As can be seen, most of the essential operating elements are outside and where they can be easily reached and watched by the engineer in charge. The interior features are equally accessible by removing detachable cover plates.

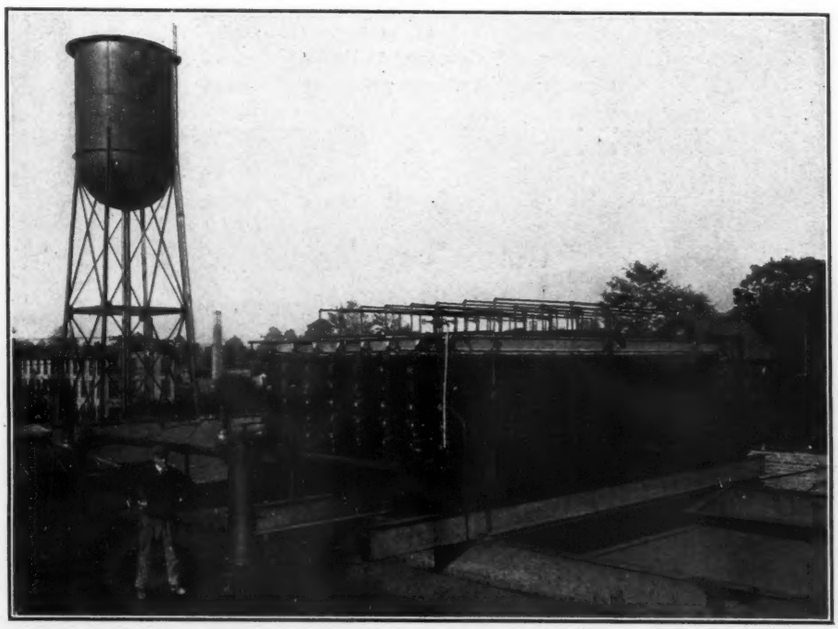
Landis Avenue, Vineland's busy main street.

Station of the Pennsylvania Railroad at Vineland.

a continuous circulation of the brine. The brine is a solution of calcium chloride. The cans are distributed and the ice is pulled by an overhead traveling crane equipped with a hoist.

The ammonia condenser, which is of the atmospheric type, is placed on the roof of the building. At present, the condenser water goes from the condenser to the sewer, but it is planned to cool this water, by spraying it upon a lattice at the base of the water tank above the wells, so that it can be used over and over again. This should make for operative economy. The hot water used in the dip tank for loosening the ice in the cans, in order to facilitate dumping, is drawn from the discharge of the oil-engine water jackets. A small electrically driven, centrifugal Cameron pump maintains the circulation in the engine water jackets and likewise delivers water to the dip tank.

The associate cold-storage plant is chilled by direct-expansion coils. One of the two main compartments will be subdivided and utilized as a sharp freezer. This will be especially useful in handling incoming poultry received from outlying farms. The keeping quality and the marketable value of cold-storage poultry are largely dependent upon the promptness and the extent to which the foodstuff is subjected to initial sharp freezing. Up to date, the ice-making plant represents an outlay of substantially $80,000; and there is every reason to believe that this investment will prove profitable to those concerned as well as a boon to the immediate and the surrounding territory.



The atmospheric condenser on top of the plant. Here it is that the hot gaseous ammonia is chilled and liquefied before it is delivered to the expansion coils to produce temperatures close to zero Fahrenheit.

Water tank over the two Artesian wells equipped with air lifts.

PRODUCTION OF ARSENIC IN CANADA

CANADIAN arsenic for many years was derived from the arsenical gold-quartz mines of Hastings County, Ont., and for a short time, in a lesser degree, from the arsenical gold mines around Arsenic Lake and Net Lake, near Timagami, in the Nipissing district of Ontario. From 1904 to the present date, these mines have been idle, and the arsenic has come almost entirely from residues—containing cobalt, nickel, arsenic, and a little silver—obtained in the mining and the milling of the silver ores of Cobalt and adjoining areas in the Temiskaming district of northern Ontario. Since 1909, the production of white arsenic has averaged approximately 2,000 tons yearly. Most of this output is sent to the United States.

Arsenopyrites are found in the ores of some of the gold-quartz mines of Nova Scotia; but the only property reporting shipments of arsenical concentrates is the Richardson mine, at Goldboro. From 1907 to 1910, inclusive, 2,413 tons, valued at $37,662, left this mine—the average content being about 39 per cent. It is estimated that from 800 to 1,000 tons of concentrates, probably containing 25 to 35 per cent. or more of arsenic, are lying on the dumps of several of the gold mines in Nova Scotia. The Mines Branch, Department of Mines, Ottawa, has started an investigation of the gold-arsenical mines of this section with the view to helping operators to resume activities.

For many years, the gold-arsenical concentrates produced in the treatment of ores of the Nickel Plate mine, operated by the Hedley Gold Mining Company, at Hedley, B. C., were sent to Tacoma, and payment was made on the gold content only. In 1917, the smelting company at Tacoma installed an arsenic burner, and since that date the Hedley concern has been receiving returns on part of the arsenic contained in the concentrates as well as on the gold values. In 1922, approximately 500 tons of arsenic were recovered by this smelter. Most of the 2,516 tons which left Canada in the years 1917 to 1920 came from the Nickel Plate mine, and was valued at $97,763.

On the whole, the Canadian production of arsenic in the form of ores and concentrates has been relatively small. In 1922, an increase of 73 per cent. in quantity but only 37 per cent. in value was noted, compared with figures for 1921. Approximately four-fifths of this amount came from the smelting of silver - cobalt - nickel ores of the Cobalt district.

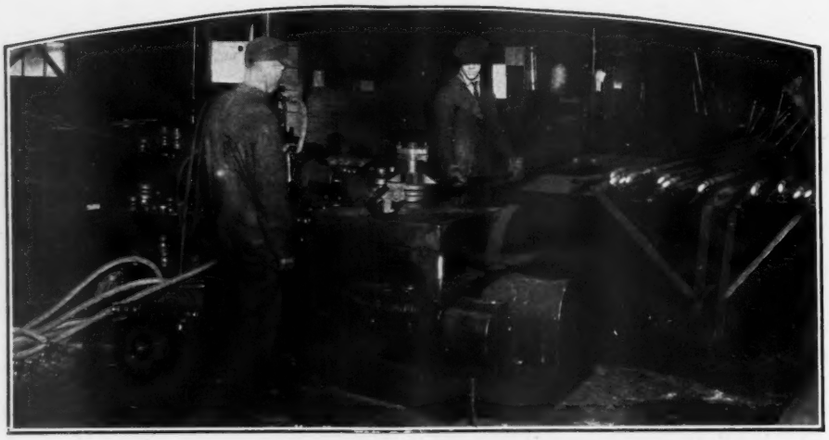
Compressed Air Plays Important Part in the Manufacture of Superheaters

By F. A. McLEAN

THERE are very few mechanical arts and trades in which compressed air is not now used in one way or another. Manufacturers of engines, boilers, stoves, automobiles, machine tools, valves, and of scores of other products depend upon air-operated equipment to increase production.

An interesting example of this kind is presented by the plants of The Superheater Company, Ltd., located in Montreal and in Sherbrooke, Quebec — the Canadian affiliation of The Superheater Company of New York City. This company manufactures superheaters for locomotive, marine, and stationary use; locomotive feed-water heaters; special pipe bends and coils for refrigeration and for oil-refining work, etc., and in connection with this work has developed a number of interesting applications of compressed air. Many of the products turned out by The Superheater Company, Ltd., are necessarily of rather complicated construction, so that extensive manufacturing facilities are essential. These include a well-equipped foundry and a machine shop.

To speed up operations and to insure castings of the highest quality, pneumatic sand rammers and molding machines are employed. Pneumatic chipping hammers, grinders, and wire brushes lighten the labor of cleaning the castings before they pass to the machine shop. In the machine shop, itself, there are a number of pneumatic drills, chipping hammers, riveters, etc., which are utilized for the general run of work such as is encountered in practically all kinds of metal-working plants. In addition to these rather common uses of pneumatic tools, the company in question has put compressed air to a number of special services so as to meet its peculiar needs.



Bending pipe pneumatically in forming superheater units.

In preparing pipe units for superheaters it is necessary to upset the ends of the piping in order that they may be ground spherically so as to form accurate ball ends to set in the header recesses, thus providing a tight metal-to-metal contact. The machine shown in one of the accompanying illustrations, which is operated by compressed air, is upsetting the pipe just back of the curved portion. Large quantities of piping must also be specially bent into shape for some types of superheater units. In this case, the bending is done by another apparatus of similar construction: one man feeding the pipe into the machine while a second man controls the bending operation.

Another important feature in the construction of these superheaters is the forged return bend, which is formed integral with the pipe and is made from the same tubing of which the unit is constructed. This is a machine-forging job throughout: no acetylene or electric welding is used in this process. The ends of the tubes are heated to a suitable temperature in an air-operated oil furnace. They are then swaged down and finished in a No. 550 "Leyner" drill-steel sharpener equipped with proper dies. The vertical stroke of the sharpener crosshead welds the associate halves of the joint together and the hammer cylinder completes the joint when the forge is made. The halves of each loop of tubing are held together by clips during this operation, and the resultant joint is as strong, if not actually stronger than each piece of tubing. The interiors of the bends are also free from distortion and obstructions of any kind. This feature is fully protected by patents.

The free ends of the tubes in this particular type of superheater are provided with ball-shaped ends which form ground joints in the header castings after the manner of the halves

Expanding copper tubes in a feed-water heater by means of a pneumatic hammer.

Grinding countersunk spherical holes in superheater header with a pneumatic drill equipped with a special emery wheel.

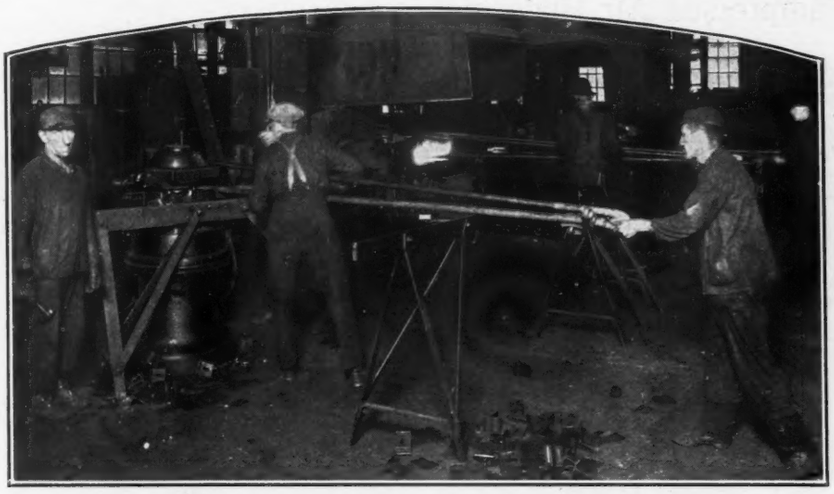
of any ordinary ground-joint pipe union. In order to secure a tight joint, the ball ends are accurately finished and fitted to a true bearing in their respective holes in the header castings. The holes in these castings are countersunk to fit the ball ends and are ground true by an Ingersoll-Rand No. 3 pneumatic drill provided with an emery wheel of special shape. It would be a slow and laborious job to try to do this work by hand, and, at that, the results would probably be unsatisfactory.

The locomotive feed-water heater built by this company consists of a nest of copper tubes contained in a cast-iron shell with suitable connections for water and steam. The tubes are secured at either end in a steel tube plate by a special grooved and tapered joint, very much on the same principle as that used in the construction of air compressor intercoolers. The tubes are joined to the tube plate by expanding the ends with a suitably tapered drift and prosser tool. This is done by two men, one using a pneumatic hammer fitted with a special swaging tool and the other a long drift or punch to back the tool out of each tube when it is finished. Naturally, the men become quite expert at this work and develop a rather amazing rate of speed.

Air for operating the various tools and appliances in the machine shop and in the foundry is supplied by an Ingersoll-Rand, single-stage, straight-line compressor and an XB-2 duplex compressor. Both of these machines are equipped with short-belt, motor-drive attachments. The receivers are so arranged that very little floor space is occupied by them.

The ample supply of compressed air available also provides a convenient source of power for cleaning machine tools, spray painting, operating air hoists, unloading fuel oil from tank cars, etc. The special applications of compressed air in this plant are a good example of the value of this medium wherever an adaptable, cheap, and reliable form of power is required. It is said that nearly 200 different classes of bending, cutting, forming, and forging jobs have been carried out on the "Leyner" drill-steel sharpener.

We are indebted to The Superheater Company, Ltd., for the photographs and the information contained in this article.



"Leyner" sharpener No. 550 in action at the plant of The Superheater Company, Ltd. The tubes are forced together by the downward stroke of the sharpener crosshead.

AIR DRILLS MAKE RECORD AT SHAWINIGAN FALLS

IN CARRYING out their operations at Shawinigan Falls, Quebec, the Greenville Crushed Rock Company has to deal with rock consisting of soft and hard layers of granite full of slips and with small bodies of white quartz scattered throughout it. The layers of granite vary greatly in hardness, sometimes cutting freely for four or five feet and then running hard for from four to six feet. These facts are mentioned in order that the following figures may be duly gaged.

The company has on this job three Leyner-Ingersoll X-70 rock drills, and since the first of these tools was employed the management has kept a record of their performances. The results are extremely suggestive, and show what can be done under unfavorable circumstances. During the month of July past, an exact record of the footage drilled and time consumed was kept for each drill. All the machines were fitted with standard 1¼-inch, hollow, round steels, with "Leyner" shanks. The starter bits were of 2⅞-inch diameter, and ⅛-inch changes on 24-inch runs were used. The depth of holes drilled varied from 12 to 22 feet, while some holes were drilled to a depth of 28 feet. The air pressure employed ranged from 80 to 85 pounds. The thing that must be borne in mind is that the character of the ground made drilling at times extremely difficult because the rock prevented the rotation of the steels; and two of the drills had to contend with material of this sort for considerable periods. Work was carried on in 8-hour shifts.

Date July	Drill No. 1	Drill No. 2	Drill No. 3
1	83 ft.		
2	75		
3	62		
4	72		
5	62		
6	76		
7	76	54 ft.	
8	67	65	
9	80	64	
10	76	75	12 ft.
11	64	74	52
12	82	76	96
13	92	105	103
14	78	86	104
16	75	74	89
17	98	84	110
18	87	74	64
19	78	66	96
20	79	53	103
21	74	70	70
23	88	75	104
24	80	85	111
26	45	60	83
28	80	65	85
29	70	55	
30	49	45	52
31	60	55	52
	2,008	1,460	1,386
Average per hour	9.3 ft.	8.7 ft.	10.2 ft.
General average	9.4 ft.		

Considering frequent delays caused by bad ground, etc., the foregoing record reveals the splendid service qualities of Type X-70 rock drill. There were no breakages of any sort; and on six different days drill No. 3 drilled more than 100 feet.

The hammer or dollying cylinder of the "Leyner" sharpener is used to finish the forging of the return bends of superheater units.

According to the latest statistics, the 1922 production of cars, trucks, and chassis in Canada exceeded the high record of 1920 by 7 per cent. and the 1921 output by 53 per cent. The total value of the 101,000 cars manufactured last year was $81,956,000.

Experiments made in Ceylon with rubber as a road-surfacing material did not meet with good results. The process consisted in melting scrap rubber and in applying it, while hot, to the roads much like tar dressing.

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EDITORIALS

CANADA AND HER RESOURCES

THIS NUMBER of the Magazine is dedicated in the main to Canada and her activities. In some ways, the Dominion is essentially youthful, but in other ways she is profoundly mature measured by resources which have come into being through vast periods of time.

With a total population below that of New York State, still Canada has at her command an area considerably greater than that of the United States. Her forests are said to contain no fewer than 800,000,000,000 feet of commercial timber and quite 1,000,000,000 cords of pulpwood. Her streams and rivers are capable of developing 20,000,000 H.P., but at the present time fully 90 per cent. of this potential energy is unemployed.

Canada has at her disposal enormous mineral wealth, and up to date she has drawn but to a trifling extent upon this natural bounty. Her mining industry has increased more than twelvefold in the course of the last three decades, that is, from $14,000,000 to $173,000,000. Canada is wonderfully favored in the matter of fishing grounds and the varieties of foodstuffs that can be garnered from them. To be specific, on the Atlantic and the Pacific, the combined extent of these productive waters totals 12,000 miles, while her fish-yielding fresh waters have an area of 220,000 square miles.

Canada possesses 300,000,000 acres of agricultural lands, but only one-sixth of this fruitful soil is now under cultivation. The Dominion has over 38,000 miles of railways, in fact one mile of this kind of carriage for every 224 persons. Canada's prosperity is closely linked with a fuller use of her railroads. In short, as others have said, "Canada needs more people and more capital to develop her fertile lands and her natural resources. The opportunities she offers are unsurpassed by any other country in the world."

OUR FINANCIAL INTEREST IN CANADA

CANADA as a robust and progressive neighbor is a pleasurable fact with which we are all familiar here in the United States; but how many of us realize the nature and the strength of the material ties which make for mutuality of interest? To a momentous extent, we have given convincing proof of our faith in Canadian industry and in the capacity and the ability of the Canadians to make the most of the wonderful natural resources at their disposal.

For the sake of those persons who may be unacquainted with the fiscal relations existing between Canada and the United States, let us briefly sum up the outstanding features of this situation: the figures are splendid evidence of our confidence and our regard. According to a recent estimate of the Bankers' Trust Company of New York City, the people of the United States have invested approximately $2,500,000,000 in Canada. About $1,200,000,000 of this amount is invested in bonds and the remainder in farms, mortgages, industrial enterprises, banking, small business undertakings, and private loans.

A Dominion statistician, Mr. COATS, estimated in 1914 that Canada had borrowed $2,700,000,000 from England as compared with $750,000,000 from this country; but the weight of dependence for additional capital has latterly been laid upon us. In commenting on the steadily increasing flow of American capital to Canada and the decrease of British investments there, the *Financial Post* of Toronto, in July of the current year, remarked: "In the eight years from 1907 to 1914 Canada sold bond issues in the British Isles to a total of $1,483,000,000 or 73.5 per cent. of the total Canadian bonds issued during that period. In the same period, borrowings in the United States were $182,000,000 or 9 per cent. of the total volume. But in the eight years from 1914 to 1922 conditions were entirely different. In that interval, Canada borrowed from England only $89,000,000 or 2 per cent. of its total volume of borrowings. And in the United States, issues were $1,530,000,000 or 33 per cent. of the total.

"These figures represent bond issues. In other forms of investment similar conditions have prevailed. There are many statistical calculations available that indicate the extent of the growth of American investment in Canada and the reduction in the proportion of British investments."

In further explanation of the fiscal and the economic ties that bind the two countries to their common advantage, the *Winnipeg Board of Trade*, in a recent issue of its informative publication, makes this statement: "Over 700 Canadian plants are now controlled by American capital, and this number is increasing at a rate of about five American plants to one British plant. United States capital practically controls the motor-car accessory industry, the proprietary-medicine and the artificial-abrasive industries of the Dominion. Sixty-one per cent. of the motor-car industry is United States controlled.

"Over 40 per cent. of the rubber, paint and varnish, brass and copper, condensed milk, meat packing, electrical apparatus, and refined petroleum industries in Canada are United States owned. Over $250,000,000 of United States capital is invested in the Canadian pulp and paper industry, or about 80 per cent. of the total capital invested in that industry. Canada's incomparable water powers are being developed largely by American capital."

HOW TO MAKE CANADA'S RAILROADS PAY

ABOUT a year ago, CHARLES CAMSELL, Deputy Minister of Mines for Canada, described in *The Canadian Illustrated Monthly* how much the Dominion railway problem depended for a successful solution upon the stimulated output of Canada's mines. In other words, he made it impressively plain that the Dominion railroads could be run profitably and operated to the greatest good of the nation only by hauling larger volumes of mineral commodities.

Let us quote this eminent authority: "In Canada, coal represented in 1919 about 24 per cent. of the total tonnage carried by the railways; but apart from, and in addition to this the mining industry furnished that year in raw materials and in partly manufactured products about 20 per cent. of the total freight, an amount greater than that furnished by the industries of agriculture, or forests, or animals. Mine products, therefore, constitute a very important part of the total Canadian railway freight. Even a layman knows that freight traffic is more profitable to railway companies than is passenger traffic, and, since the mining industry furnishes such a large percentage of the total tonnage carried, it follows that the more highly developed the mining industry of this country becomes the more will our railways benefit by it."

MR. CAMSELL does not stop with this broad assertion but goes on to detail just why Canada must do more mining to make her railways pay. Continuing, he says: "It has been stated, and with good grounds, that not more than one-fifth of all Canada is suitable for the profitable pursuit of agriculture. The remaining four-fifths can only be utilized for such industries as fishing, lumbering, fur farming, and mining; and from the railway point of view the most important of these is mining."

Widespread and active as are the railroads in the United States, we have one mile of railway for every 416 of our inhabitants while Canada has a mile for each 224 of her citizens. Manifestly, Canada's lines must traverse great stretches of her territory that contribute comparatively little to the support of steam trans-

portation. In 1920, the latest figures available, America's mines and partly manufactured mine products furnished 69 per cent. of the total tonnage carried by the railroads. Further, aside from contributing twice as much tonnage as all other industries combined, mining and mine products actually utilized only 53 per cent. of all cars employed in transporting revenue freight in carload lots. That performance represented a source of very substantial income to the roads and incidentally revealed what the efficient use of rolling stock could do.

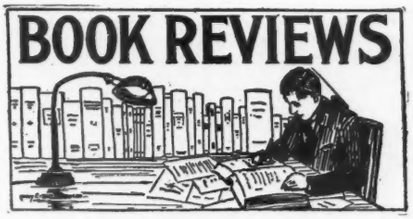
Because of her mineral wealth, and the economic importance of these riches, Canada must bend her efforts toward working her mines intensively so that that branch of industry may do its full and commensurate share in supporting the Dominions's railways. What the United States has done in this direction Canada can, undoubtedly, duplicate.

MR. F. W. COOK, Vice-President of the San Antonio Portland Cement Company, died Monday afternoon, September 3, 1923, in the Presbyterian Hospital at Chicago, after an illness of approximately two months following an operation.

Mr. Cook was born in Louisville, Ky. He attended the University of Indiana, and later studied in the famous University of Heidelberg, Germany. After completing his studies in Germany he returned to the United States and entered the employ of his father's bank at Evansville, Ind., where he remained for six years. Mr. Cook came to San Antonio, Tex., in 1895, and shortly afterwards associated himself with the San Antonio Drug Company. In 1908, in connection with Mr. C. Baumberger and Mr. A. Kronkosky, he organized the present San Antonio Portland Cement Company—successor to the old Alamo Cement Company—of which he was vice-president from the time of its inception until his death. He was continuously active in the affairs of the San Antonio Portland Cement Company; and for the past twelve years he was first a member of the Board of Regents of the University of Texas and, subsequently, and until the time of his death, President of the Board. He was Chairman of the Board of Directors of the San Antonio Drug Company and a Director of the Commercial National Bank of that city.

KEEPING THE ST. LAWRENCE OPEN IN WINTER

A MONTREAL dispatch to the *New York Journal of Commerce* reports that R. S. Lea, consulting engineer for the Ontario Power Commission, seriously proposes keeping the St. Lawrence open through the winter months. Mr. Lea has heretofore studied the problem of ice clearance purely from the point of view of power development; and he claims that the use of modern turbines and the application of heat or compressed air have entirely disposed of the trouble that used to be met with in the power house by reason of ice. He is now satisfied, because of his researches, that it would not be a particularly difficult task to keep navigation open all winter either above or below Montreal.



HIGHWAYS AND HIGHWAY TRANSPORTATION, by George R. Chatburn, Professor of Applied Mechanics and Machine Design Lecturer on Highway Engineering, University of Nebraska. An illustrated volume of 472 pages, published by Thomas Y. Crowell Company, New York. Price, $3.00.

TO THE LAYMAN as well as to the technicist, this entertainingly written work should hold, in fact does hold, much to interest. Most of us are so busy getting about from one point to another in meeting the daily demands of business or the calls of pleasure that we give little heed to what the means of transportation at our disposal indicate in the way of human progress. The author has entitled his opening chapter, *Transportation a Measure of Civilization;* and from the first to the final page of his work he develops this theme in an absorbing and an informative manner. He shows convincingly just how the highways affect each and all of us—how intimately good roads and the easy and safe movement of diversified traffic concern the comfort, the convenience, and the industrial conditions in every department of national existence.

Professor Chatburn has summarized his book as "a glimpse of the vast development of the humble road and its office as an agency for transportation"; but as a matter of fact it is the lucid presentation of one of the most complex and pressing problems now confronting us. With the coming of the motor truck and the pleasure car, thousands of miles of roadway have been scrapped as obsolete and unsafe. What types of road construction are best fitted for permanent use? How may they be improved and safeguarded? These are some of the questions which this recognized authority has undertaken to answer.

CYCLES OF UNEMPLOYMENT IN THE UNITED STATES, 1903-1922, by William A. Berridge, Assistant Professor of Economics, Brown University. A volume of 88 pages, with charts, published by Houghton Mifflin Company, Boston and New York. Price, $1.25.

THE PURPOSE of this really excellent book is to answer certain social-economic questions that intimately concern national well-being. The author has brought together data from a variety of sources and shows just how this information can be utilized in preparing an index of unemployment and in using such an index as a reliable forecaster of business conditions. He also answers the query: "Exactly what relations have prevailed between employment and production?"

In conclusion Professor Berridge says: "The close linkage which has been shown to exist between cyclical employment and certain of its economic correlatives should lead all who are interested in employment fluctuations—whether for commercial or industrial or sociological purposes—to keep in touch with current employment measurements, and with the business forecasts of reputable statistical agencies. Eventually, perhaps, we shall achieve control over some of the more harmful phases of the business cycle. But until this is done, the possibility of tracing the current fluctuations of employment, and of forecasting its future fluctuations several months in advance, may go far to alleviate the evils due to the intimate relation between unemployment and business cycles in the United States during the last twenty years."

BLUEBOOK OF SOUTHERN PROGRESS, 1923 edition, published by the Manufacturers Record Publishing Company, Baltimore, Md. Price, $0.50.

THIS WORK contains a wealth of authentic facts and figures pertaining to the South and should be of value to anybody interested in that great and steadily advancing section of the country. The editors declare: "The South is moving forward from the dawn of the sunrise of prosperity to the meridian splendor just ahead," and in confirmation of this gripping pronouncement there is an imposing procession of monumental figures.

We are told that in nearly all lines of human progress, material and educational, the South today with 36,000,000 inhabitants is far and away ahead of the United States in 1880 with 50,000,000 inhabitants. The South of today has $4,000,000,000 more of capital invested in manufacturing than the whole United States had in 1880. The production of coal in the South last year was 158,000,000 tons as compared with 71,000,000 tons for the entire United States in 1880. The South produced last year 325,000,000 barrels of petroleum in contrast with the 26,000,000 barrels for the United States in 1880. The value of the South's agricultural products last year was $5,291,000,000, which is offset against the $2,212,000,000 which represented the total value of farm products throughout the length and breadth of the nation in 1880. The South's railway mileage is almost exactly that of the United States in 1880; and the value of its exports exceeds by $500,000,000 the total exports of the United States in 1880.

The foregoing are only a few of the amazing details of the growth of the South which is revealed by this admirable annual.

OFFICIAL REPORT OF THE TENTH NATIONAL FOREIGN TRADE CONVENTION, held at New Orleans, La., in May, 1923. This book is issued by the Secretary of the National Foreign Trade Council, India House, Hanover Square, New York City. Price, $2.50.

IT IS NOT practicable to review here the many and the excellent addresses made and papers read before the convention. It will have to suffice for us to say that a wide variety of topics was offered for consideration, and these touched closely upon foreign-trade problems that have to do with the welfare not only of the people of the United States but of those of foreign nations with which we have to deal and upon whose prosperity our own interests depend in some ways.

In its final declaration, the convention went on record in positive terms regarding our shipping problem, which it recognized as a ques-

tion of paramount importance to us as American citizens and as foreign traders. To quote: "The merchant marine act of 1920 is a mandate for private ownership and operation. Already considerable progress has been made. Private American shipowners owned on April 1st last a total of 5,962,133 tons gross register of ocean going shipping. This is exclusive of 2,723,857 gross tons employed on the Great Lakes. On that same date the Shipping Board owned 7,169,717 tons gross register of which probably one-third is fit only to be scrapped. . . .

"It is recognized that there are some services of importance to the national interests and the proper growth of our trade, which cannot yet be taken over by private capital. In such cases we should not relinquish our share of the carrying trade, but these services should be continued under the present system of operation until they develop to the point where they can be maintained under private ownership. . . . Every effort should be made to give American owners the opportunity to show that American skill, experience, and resourcefulness can do in the operating of ships what they have done in other lines of competition with foreign nations."

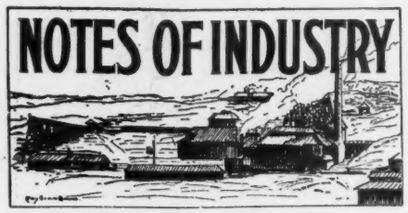
Drilling Shale is the title of an interesting paper read by Mr. A. A. Paoli before the Twenty-first Annual Convention of the Canadian Clay Products Association. As the author expressed it: "The 'Jackhamer' has always been popular for 'pop shooting' but it has only recently been found indispensable in the quarrying of shale. For bench drilling, downhole drilling, and general usage the 'Jackhamer' is now regarded as a necessity." Mr. Paoli developed his subject understandingly and comprehensively, and much that he said may be of value to those in this industry that have not yet adopted this tool.

AN IDEAL GOLD MINE

THE Hollinger mine, in Ontario, may be said to be the nearest approximation to the ideal mine, and, besides, the greatest individual producing mine in the world. It dates back only to 1911, and yet it already comprises over 60 miles of workings. Its plant handles over 4,400 tons of ore per day; and it has, up to the present, yielded gold worth $60,000,000 and has paid about $20,000,000 in dividends.

Considerable developments are now in progress. A shaft is to be carried to a depth of a mile—the workings being in levels 100 feet apart. Over three-quarters of the production to date has been drawn from above the 800-foot level, and about 75 per cent. of the actual ore reserves are still in place above that level. The company rather peculiarly divides its fiscal year into 13 periods of 28 days each; and a dividend of one per cent. ($246,000) is paid for each period.

Capital employed in the Canadian automotive industry in 1922 has been estimated at $47,760,000.



Next to the United States, Canada and Italy are said to be the only known countries that might produce helium in commercial quantities.

One of the world's most important gypsum beds has been discovered by an Ontario prospector. The deposit, which we are told is 99.8 per cent. pure, stretches for a mile along a branch of the Moose River midway between Cochrane and James Bay and extends inland for a distance of about ten miles.

In the last decade, the number of farms in Manitoba has been increased by about 9,000, or at the rate of 1,000 a year. There are now more than 53,000 occupied farms within the province with a total acreage of 14,600,000. The value of the property, based on the 1921 census, is estimated at $656,500,000.

According to figures furnished by the Canadian Commissioner of Trade, more than one-half of the Dominion's trade in the fiscal year ending June 30, 1923, was with the United States; and the indications are that in the further development of Canadian commerce the interchange of products with the United States will continue to be bigger than that carried on with other countries. Within the twelvemonth, the Dominion purchased goods from the States valued at $585,732,788 and sold to this country $394,246,215 worth of commodities. In both cases the values were greater than those for the year ending June 30, 1922.

In the event of a coal shortage in the New England States this winter, Nova Scotia is prepared to supply them with large quantities of the fuel. It seems that the Canadian market does not require all the coal that can be mined in that section of the Dominion and is, therefore, disposed to divert the surplus to the United States.

Canada has a record crop this season, and the demand for binder twine is, therefore, large. It is estimated that 25,000,000 pounds of twine will be distributed from Regina, alone, while the entire Province of Saskatchewan will use about 100,000,000 pounds.

The Province of Saskatchewan is rich in deposits of clays of various kinds, and these raw materials are expected to prove of much value industrially to what are known as the Prairie Provinces. The clays have been found suitable by the Dominion Department of Mines for building brick, structural and agricultural tile and sewer pipe, pottery, and fire brick.

In correspondence, the use of figures for the day and the month is sometimes a little confusing, and *Commerce Reports* calls attention to the fact that transatlantic practice is the opposite of ours. In the United States and Canada, May 6 would be written "$^{5}/_{6}$," but in all other parts of the world it would be "$^{6}/_{5}$." Exporters should be careful.

The Dominion Bureau of Statistics reports that 50,686 students registered this fall in the universities and colleges of Canada.

The forest lands of Canada, 85 per cent. of which are publicly owned, yield an annual revenue of about $500,000,000. This return represents the income derived from all the branches of the forest-products industries, in which more than 100,000 men are engaged in one way or another.

More than 50 per cent. of the total area of forest lands in the British Empire is in the Dominion of Canada.

There has been taken from the Keeley mine in northern Ontario a block of silver ore weighing more than two tons and estimated to contain over 20,000 ounces of silver—a record-breaking lump. It is to be placed in the Parliament Building as a Government exhibit.

It is estimated that this season's wool clip controlled by members of the Southern Alberta Sheep Breeders' Association will amount to about 1,000,000 pounds. This means practically all the wool in the southern part of Alberta.

The present capacity of the government-owned grain elevator at Port Colborne, Ontario, is to be doubled this year. A few weeks ago an appropriation of $350,000 was made for this work, and construction is expected to begin shortly. The present capacity of the elevator is 2,000,000 bushels.

The exclusive use of all-steel trains on the main lines of the Canadian National Railways has been made possible by the recent delivery of 30 all-steel baggage cars and 41 all-steel first-class coaches. Among the large orders for railroad equipment recently placed is one for 1,000 automobile cars, to be built in the United States at a cost of $3,000,000.

Only once in the history of Canada was the gold-production record set in 1922—when 1,263,364 ounces were mined in the Dominion—exceeded, and that was in 1900, when the Yukon placers reached the peak of their yield. The value of this precious metal is estimated at $26,116,000, an increase of 36 per cent. over the previous year's output. In 1900, the gold mined was worth $27,908,153, and amounted to 1,350,057 ounces.

Shipments of lumber from British Columbia via the Panama Canal, which service was inaugurated last year, seem to have become permanent. A shipment of 5,000,000 feet is now en route; and the total importations at Montreal may reach 40,000,000 feet.